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Fire Fighting and Fire Prevention

FIRST ARTICLE IN A SERIES DESCRIBING FIRE PROTECTION SYSTEM OF A MODERN LOFT BUILDING. DETAILS OF DOOR AND WINDOW CONSTRUCTION AND ALARM SYSTEMS ARE GIVEN HERE. BY FRANK WILLIAMS

NOW LET US CONSERVE human life." These words mark the underlying principles of the recent safety movement and may well be named as the basis for the subject of this article, especially when it is realized that conservative estimates of experts place the avoidable loss of life at 75 per cent of the total deaths now generally caused by lack of or poor fire prevention methods and fire fighting facilities.

ing about the machinery or other apparatus used in the industry, still there remains the common hazard of fire, because a more or less extensive stock of combustible material is usually stored in the premises. To guard against the loss of life through this cause, fire prevention methods must be resorted to.

Fire prevention methods, though not numerous, are distinctly varied in application, but usually consist of a direct means for rapid egress, a signal system, and fire fighting appliances, each of which may be more or less extensive, but all means should be simple to use.

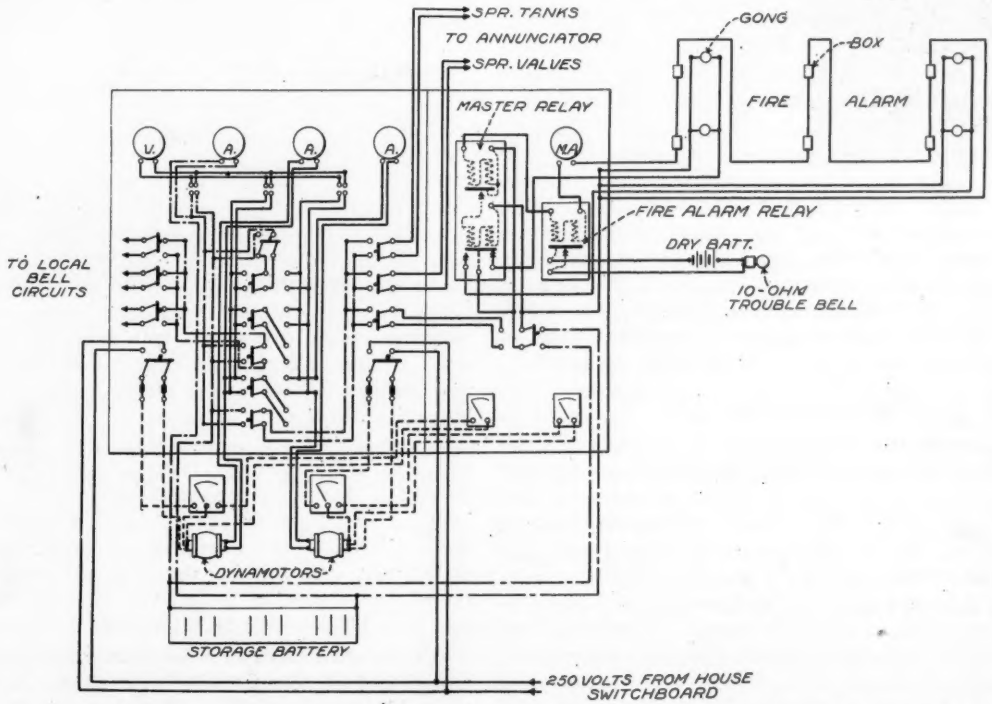


FIG. 4. WIRING DIAGRAM FOR LOW-TENSION SWITCHBOARD FOR FIRE PROTECTION SYSTEM

The modern light manufacturing buildings of large cities, known as loft buildings, usually house many hundreds of persons, and though a means of protection is sometimes provided for the safety of the employes work-

No attempt will be made to detail the numerous appliances on the market, or those which may be utilized in a thoroughly protective system; but in lieu of such

details, a description of an actual system is given, which, perhaps, with some additional notes in the passing, may prove of greater interest.

The building taken under consideration is a tenanted loft located in the manufacturing center of the Metropolis, and consists of 11 stories and basement, which houses a private steam-electric plant. It is of heavy fireproof construction, having steel floor framing supported by round cast-iron columns. The floors are formed by concrete slabs and the columns are thoroughly protected by concrete plaster. The floors each have an area in excess of 26,000 sq. ft., and with a total height of 150 ft.; this gives a volume of 4,000,000 cu. ft. Three sides of the building have street fronts and the fourth side is also open to a street above the seventh floor, as up to that height there is a small adjoining building. Together these 2 structures occupy an entire city block. The loft building under discussion accommodates 1100

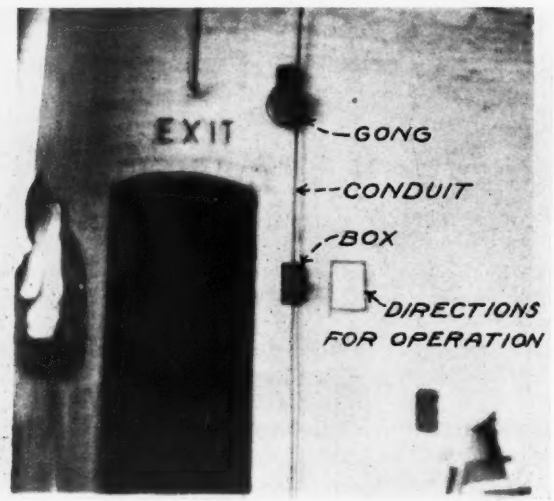


FIG. 1. EXIT AND FIRE ALARM SYSTEM

to 1200 people at various times and with a complete fire prevention system and methods, such as further detailed below, the protection afforded becomes such as to reduce the fire risk to a minimum, and is therefore a step towards the conservation of the lives of the occupants.

Fire-Escapes and Doors

In place of the usual flimsy and unsightly exterior balcony fire-escapes, the building is equipped with 3 fire-proof, reasonably straight and direct stairways, each entirely enclosed in a brick shaft, having fire doors at each landing. The 5 main electric elevators are similarly enclosed. There are also 2 short-run elevators serving only 3 floors; these are in harmony with the general building construction. Of course, the stairways are intended as the general means of egress in time of peril, without the dependence of elevator service, and each terminates at a separate street exit.

The door at each stair landing is of fireproof construction, 2 ft. 9 in. wide by 6 ft. 9 in. high, and made up in the same manner as ordinary wood doors with mortised joints and neatly paneled, then metal lined. Such doors are sometimes distinguished by the name kalamein. This term is descriptive of a process in which the sheet metal covering is drawn through dies and shaped to the forms of the various moldings or door panels, thus being covered, and the metal edges are pressed tightly into the wood. Some of these doors are fitted with panels of wire glass, while others are solid. They are all 2-in. self-closing doors, swinging outward, and are kept unlocked during working hours. It is a dangerous practice to have the doors locked while the building is occupied during the day or even have them open inward, for, in case of fire, the rush would be mainly toward the doors, and in attempting to escape, the crowds would surely jam the door shut, even if it were unlocked, and thus human lives would be unnecessarily sacrificed.

Doors constructed as above described, even though they are fireproof, are not so efficient in fire resisting qualities as the Underwriters type of fire door. Of course, the fire door, when built in accordance with the insurance regulations, cannot be made as neat appearing as a kalamein process door, and that is the reason it is used almost exclusively in factories; however, a description of an Underwriters door may not be out of place.

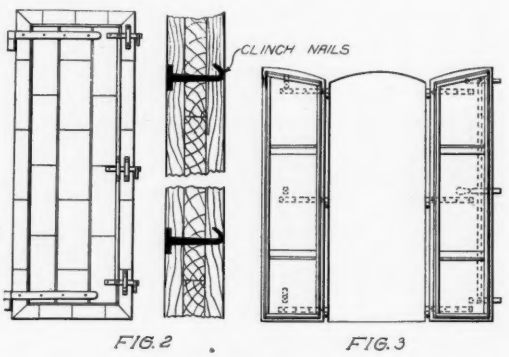


FIG. 2. TIN-CLAD FIRE DOOR
FIG. 3. STEEL FIRE SHUTTERS

Fire doors should have a wood core, made up of 3 layers of well seasoned stock, preferably white pine, matched boards, dressed on both sides, 13/16 in. thick and 6 in. wide. Each layer should be set at right angles with respect to each other, which can be accomplished by setting the 2 outer layers in a vertical position, and the inner boards in a horizontal position. These 3 thicknesses should be securely fastened together by wrought iron nails driven in flush and clinched so as to leave both door surfaces smooth. A good grade of tin plate should be used for covering the 2 sides and all edges of the wood core forming the door, and these should be thoroughly secured with lap or lock joints having not less than 1½-in. nails in the seams.

Care should be exercised in placing the metal covering so that the sheets will be flat against the door so as to avoid air-spaces. No solder should be used at any joints or other part of the door. The hinges, latches, and other hardware or trim should be securely bolted to the door, but only after the tin covering has been applied. Hinge hooks or wall eyes should be built into the walls or riveted to the steel door frame where this is

used. A swinging door 2 ft. 9 in. wide and 6 ft. 9 in. high, built in accordance with the above, would cost about $35, hung in place.

The building under discussion is equipped with 34 kalamein doors as previously described, and these aggregate an installed cost of about $1190. Over each stairway landing or door there is provided a red electric bulb, independent of the general lighting facilities and wired in rigid iron conduit. Adjoining each of these lights are the words "Fire Exit," marked in 4-in. red letters, or the word "Exit" marked with 10-in. letters of similar color. This, of course, aids in pointing out the location of the stairways, a consideration found quite desirable in time of a panic, as the excited people, not generally accustomed to the use of these fire-escapes, seem to lose the presence of mind and forget the locations of them or the purpose for which they are intended.

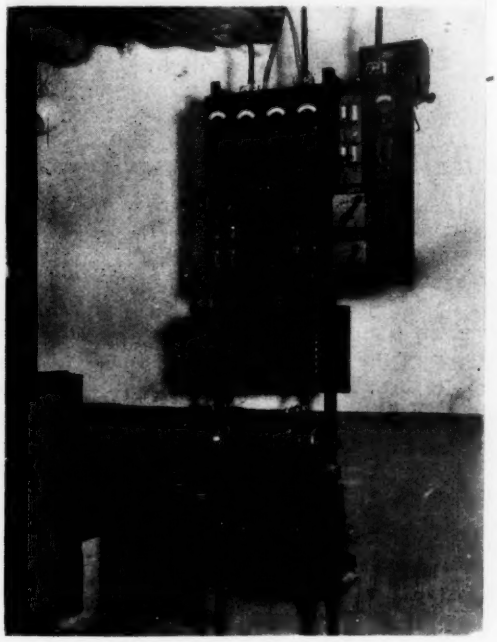


FIG. 5. LOW-TENSION SWITCHBOARD

The fire-doors, of course, and the shaft enclosing the stairways are designed so as to keep the means of escape clear of the flames during a fire, for open stairways and elevator hatchways are natural flues and cause up-drafts; but when entirely enclosed, they prevent fire from spreading to other floors, and thus provide a reasonably safe means for egress. The provision of these exit lights and signs cost about $225.

Windows

Next in line with doors come the windows. These conform to the general fireproof features of the building, being made up of metal sash glazed with heavy wire glass. The north wall of the building has windows at the eighth floor and above, which open to the street having the small adjoining building. On account of this exposure, it was found desirable, in order to take advantage of a decrease in the insurance rates, to protect this side of the building additionally by equipping the openings with fire-shutters and thus reducing the outside fire hazard to a minimum. The 72 pairs of shutters installed cost $2436. Normally, during working hours, these shutters are open; but at night, on Sundays, holidays and all other times when there are no people in the loft, they are closed and secured by latches.

Shutters are made of No. 14 gage steel plate, 1½ in. larger than the sides and top of wall openings, and fitted close to the sill at the bottom. They are reinforced by frames of 1½ by ¼-in. angle iron and cross-bars of the same material. The frames around the inside of shutters are arranged so as to fit the window openings when shutters are closed. Three strap iron latches, spaced vertically, and cross connected so as to work in unison with a handle on the inside of the building for operating them, are provided for each pair of shutters. Strap iron hinges of 2 by ¼-in. material are also provided, and the whole hung on ½-in. round iron pins firmly anchored in the walls.

Alarm System

As it is realized that most people are in duty bound to spread a warning when approaching danger is discovered, a means of transmitting such alarm to all portions of the area affected should be provided, and so it is found that this loft building is equipped with an electrical signal service in the form of a complete interior fire alarm system.

This fire alarm system consists of multiple series closed circuits in rigid iron conduit comprising 36 boxes or stations in series and 25 signal gongs in multiple, all installed by the chief engineer of the plant at an expenditure of $760 for the required material. If this work had been done by an outside contractor, it is safe to assume that the total cost would approximate $1600.

Two lines of fire-alarm boxes and gongs, with the exception of a few, are located near the fireproof doors of the east and west stairways on every floor, whereas at the south stairway there are only fire alarm boxes, all arranged so as to be in the direct line with the natural path of escape during a fire. The boxes are of cast iron, oval in shape with an inner door protecting the mechanism and contacts from dust and moisture. On the front of this door is mounted the lever for sending the alarm. This inner casing is again enclosed with an outer door, making the whole dust and fume-proof when closed and in normal condition. The top and bottom of the boxes are provided with outlets for ½-in. iron conduit which might be advantageously changed to ¾-in. outlets for convenience in pulling the wires through. Room is provided at the back of the box, inside the casing, to fasten the electric wires to the terminals and to pass through to the next connection. The gongs are 10-in. vibrating bells, enclosed type, mounted directly above the fire alarm stations in each of the 2 sections of the building.

A part of the low-tension switchboard located in the engine room and also used for sprinklers and house circuits, has mounted on it a master combination relay, fire alarm relay, milli-ampere meter and double-throw knife switch for the current control of the system. To the back of the board is mounted a cabinet with 4 dry cells and a 3-in. trouble bell. There are 2 sources of current supply, one being a dynamotor and the other a

storage battery. The 6 wires from the switchboard are run in ¾-in. rigid iron black enameled conduit, then branching across the basement with 4 wires to each of the fire alarm stair risers. The conduit is reduced to ½-in. on account of the outlets at the fire alarm boxes. The wires are all No. 14 B. and S. size rubber covered, single braid, Underwriters' standard. The horizontal conduit lines are well supported by means of hangers attached to the beams, whereas the vertical runs are supported by the connections between boxes and bells, the boxes proper being mounted on wood back-boards and secured to the walls.

All the boxes are arranged for silent test which can only be made by the engineer of the plant, as he keeps the key required. This test is intended to show whether the box mechanism is in proper working order, and is carried out without ringing the gongs. Each box has cast on it directions for sending an alarm; but as an additional precaution, printed instructions covered with glass and framed, are mounted near each box.

To send an alarm from any part of the building, the door of the nearest box must be opened and the lever on the inside pulled down. This automatically winds the mechanism, thereby breaking the circuit which excites the relays and simultaneously actuates all the bells throughout the system, thus sounding the signal of that particular box from which the alarm was sent in. Of course, the trouble bell would also sound the signal; but, should the box circuit be accidentally broken at any time, or the circuit fail on account of run down batteries, then the bell would ring continuously until the trouble had been remedied, and the system left in proper working order.

The signal code used in this system is very simple, all boxes on one floor having the same code number. The boxes are arranged to repeat the signal 3 times after the alarm has been sent in by pulling the lever once. To distinguish the fire-alarm signal from other call bells, 3 rings or taps precede every alarm, and the signal proper corresponds to the number of the floor. Thus 3-1 would indicate the first floor alarm, and the second floor signal would be 3-2, and so forth for the remaining floors.

(To be continued.)

Blower Installations and Air Ducts

VARIOUS ARRANGEMENTS FOR FORCED DRAFT STOKERS. BY R. A. LANGWORTHY

THE field of the forced draft stoker is rapidly increasing each year, both in new power plants and the application of stokers to existing plants for the purpose of increasing their capacity. An important feature in the success of such installations is the blower equipment and air ducts. These points often receive scant attention, with the result that many inferior layouts are in evidence, seriously affecting the whole boiler room performance. It is the purpose of this article to call attention to some details of such equipment and point out a few of the faults which are apt to be present.

The number of blowers or fans will depend upon the size of the plant. Large plants often adopt the unit system of a blower for each battery of boilers. This has many advantages, as it keeps the size of the blowers and air ducts down to practicable limits and simplifies the layout. The majority of the plants, however, use 1 or 2 units and the discussion will be limited to such layouts.

The type of equipment may be divided into the following 2 classes:

Steel plate paddle wheel fans, running at speeds between 300 and 500 r.p.m., depending upon size and pressure.

High-speed, multi-blade blowers, running at speeds between 700 and 1800 r.p.m.

These speeds are approximate only, and are stated to give an idea of the range encountered in practice. The majority of installations will be found within the above limits, except for very large, or very small units. The fans are usually engine driven, while the blowers are either turbine or motor driven.

All units should be installed on good substantial foundations, as vertical engines and high-speed turbines are especially susceptible to vibration. See that the air inlets are not placed close to a wall or obstructed in any way, as a free inlet of the air to the fan is necessary. Do not place the unit in a small closed room which will cut off the air supply. A considerable amount of trouble with the capacity and pressure of fans can be traced to the above source, so that it should receive careful attention. It is a good plan to place screens on the fan inlets as a safety measure.

Fans and blowers for forced draft stoker work are usually required to maintain a static pressure of 5 to 6 in. water gage at the fan outlet, and this, coupled with the sudden and continual speed changes due to the regulation of the air supply, tends to make the service very severe. The ordinary commercial fan is not suitable for this work. The units should be provided with heavy, well braced wheels and substantial bearings. The latter should preferably be carried on cast-iron pedestals independently of the fan casing. In case one fan supplies the entire plant, it is a good scheme to install it with an engine on either side and proper couplings with spacing pieces for emergency use. Engines should be of the enclosed, self-oiling type.

Having purchased a good fan, give it a square deal in laying out the air duct system. The over-all efficiency of the fan and ducts is the really important thing and a very efficient machine may be fatally handicapped by improper installation.

The run of the ducts and branches should always be as short and direct as possible with long, easy bends at all turns and no abrupt changes in cross section. While the round duct section is theoretically superior in efficiency, the square duct is generally used for practical reasons. The inside surface should be as smooth as possible and air leaks carefully guarded against. For conservative practice, the cross-sectional area should

be sufficient to keep the velocity down to 3000 ft. per min., or less. There is always a temptation to cut the duct area, at the expense of efficiency.

When the area of the duct varies, the changes in section should be made by means of tapered connections or by tapering the whole duct. Concrete ducts placed under the floor have many advantages, such as appearance, permanence and flexibility as to shape and size of section. They also leave the plant free for other apparatus, and in most cases the first cost is not much greater than the metal duct. When metal ducts are

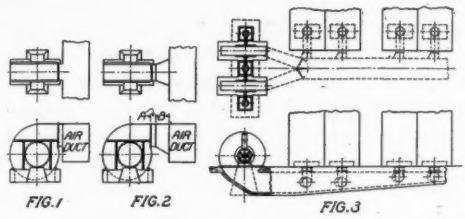
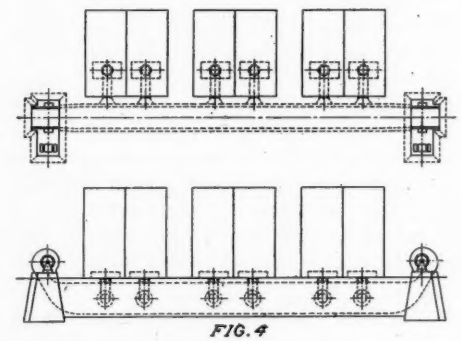
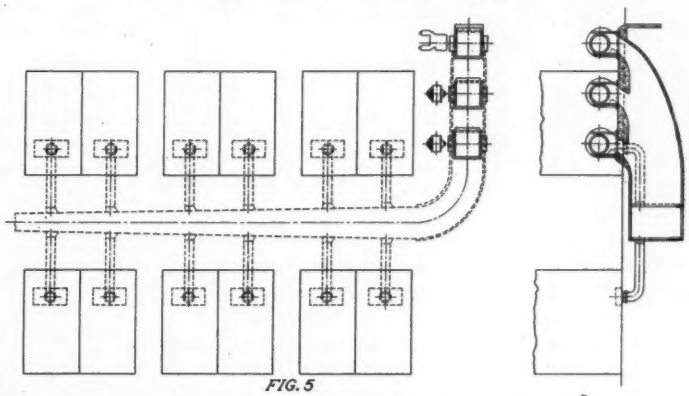


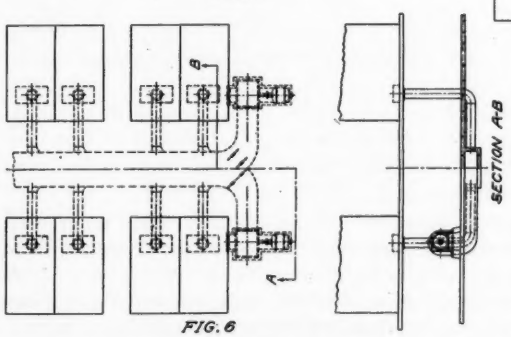
FIG. 1. INCORRECT CONNECTION OF FAN TO DUCT
FIG. 2. EXPANDING CONNECTION BETWEEN FAN AND DUCT
FIG. 3. TWO FANS AT END OF DUCT

A scheme often suggested, which is absolutely wrong, is indicated in Fig. 1. The air as it leaves the fan discharge strikes directly upon the flat surface of the duct, breaking up the continuity of the air stream and causing eddies, which are fatal to efficiency. It is unfortunate that this very scheme is often dictated by local conditions at the plant. When it is absolutely impossible to change the location of the blowers, the disadvantages of the layout may be to some extent neutralized by placing the fan further from the duct, and using a transforming section as shown in Fig. 2. The straight section, "A," should not be less than 12 to 15 in. long, and the transforming section, "B," from 3 to 4 ft. long. The expanding section of duct partly transforms the velocity of the air into static pressure increases the efficiency. Good examples of duct layout are shown in Figs. 3, 4 and 5.

Figure 3 shows an arrangement of 2 fans at one end of the duct and makes a very satisfactory installation. The flow of air is straight and efficient, one damper serves for both fans, the equipment does not require much space and one engine placed between the fans will serve as a spare for both. Foundations and duct are also less expensive than for fans placed separately.







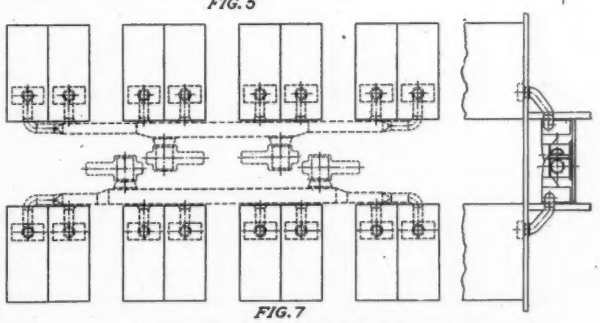


FIG. 4. FAN AT EACH END OF DUCT
FIG. 5. COMPACT 3-FAN ARRANGEMENT
FIG. 6. TWO-FAN ARRANGEMENT FOR DOUBLE LINE OF BOILERS
FIG. 7. COMPACT 4-BLOWER LAYOUT

used, particular attention should be paid to the support, bracing and air tightness. The plate should be 3/32 to ⅛ in. for small ducts, and 3/16 to ¼ in. for large ducts. Sections should be well braced and the rivets pitched close enough to allow of proper calking; 3 to 4-in. pitch is usually sufficient. Provide manholes in ducts of any construction to allow of access for inspection and repair. Where metal ducts are run through or in the ash pit, such sections should be made of cast iron.

Figure 4 shows an installation with a fan at each end of the duct, which is of common occurrence. The lead from the fan should be on a long radius curve, as indicated. Fans should rotate in opposite directions to insure proper flow of air.

Figure 5 shows a compact and efficient installation of 3 blowers, all at one end of the duct. One unit was a reserve and was driven by a steam turbine. The 2 regular operating units were motor driven by constant speed, alternating current motors. Air pressure was regulated

by louvre dampers placed directly under each blower and automatically controlled. The direction of the air leaving the fans was continued by a gradual sweep into the duct and then an easy right angle bend carried it into the longitudinal run.

Figure 6 shows a common variation of Fig. 3, which is good practice. Figure 3 is adapted to a single line of boilers, while Fig. 6 may be used for a double line of boilers.

All of the above figures show a concrete air duct, but the application of the same schemes to a steel duct either below or above the fans is obvious.

Figures 7 and 8 show layouts with steel air duct. Figure 8 is a good layout of duct suspended under the first floor, with fans in basement. Figure 7 is a layout of 4 blowers and duct in a very restricted space which

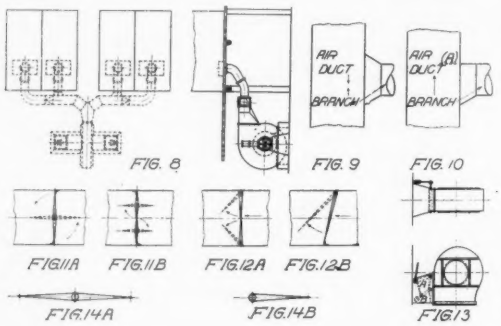


FIG. 8. SUSPENDED DUCT WITH FANS IN BASEMENT
FIG. 9. BRANCH OFF WHERE AIR COMES FROM EITHER DIRECTION
FIG. 10. BRANCH OFF WHERE AIR COMES FROM ONE DIRECTION ONLY
FIG. 11. SINGLE AND 2-LEAF DAMPERS
FIG. 12. FORMS OF REGULATING DAMPERS
FIG. 13. REGULATING DAMPER FOR LIMITED SPACE
FIG. 14. SIMPLE BUT EFFECTIVE DAMPERS

is by no means ideal, but the best that could be obtained under the conditions. The blowers were placed as far as possible from the duct with transforming pieces and were designed for an unusually high static pressure to compensate for loss in efficiency.

A large number of layouts might be shown along these lines, but the above will be sufficient to indicate the general principles which should be followed. Special attention should be given to the duct at the fan discharge, for it is here that a poor design will do the most damage. Lead the air from the fan along easy lines and do not attempt any decided change in direction with 3 or 4 ft. of duct length.

While not as important as the fan discharge, the branches from the duct to the stokers should receive proper attention. The best lead would in most cases be at a decided angle to the main duct, but practical considerations will in 9 cases out of 10 make it necessary to take the branches off at right angles. Figure 9 shows a branch off which may be used when the air is apt to come from either direction. Figure 10 shows a branch off which may be used when the air always flows in the same direction. The air flow is indicated by the arrow and by cutting off one corner, as shown, the branch will tend to take its share of the air. If the air distribution is not satisfactory, the branches which are not getting their proper share, may be provided with a deflecting baffle, as shown at A, Fig. 10. Baffles should be used with caution, however, as they are apt to cause eddies in the duct. The proper size and location can only be determined by experiment. Any turns made in the branch after leaving the duct should have a long radius. Never use a sharp right angle bend.

Dampers should be of the balanced type when possible. They should be provided with stops for air tightness when closed, and care should be taken to ensure easy operation. All dampers, especially those used for regulating purposes, should be designed to offer no obstruction to the air when open, and to offer an easy passage, with minimum tendency to cause eddies, when partially open. A damper should be placed at each fan outlet so that it may be completely shut off from the duct.

Figure 11a shows an ordinary balanced damper, while Fig. 11b is a 2-leaf louvre damper. The latter can be made with more leaves; but 5 or 6 is the maximum which will operate properly in ordinary practice. Figure 12a shows a good type of damper for regulating purposes, as it offers an easy passage for air in any position. Figure 12b is the same idea, but not so good as 12a. Figure 13 shows a clever regulating damper which recently came to the writer's attention. It was applied in very limited space to a duct section which tapered both ways, and offers a proper passage for the air in any position. One peculiarity which should be noted is that while the travel of (A) is 90 deg., the travel of (B) is less, so that the outside operating levers should be of different lengths to compensate for this.

Figures 14a and 14b are simple, cheap and effective dampers. The spindle should be 1¼ in. diameter, and the plate 3/32 in. thick, for the smaller sizes and correspondingly for the larger sizes. This type of damper is light and stiff, and does not unduly obstruct the flow of air.

When dampers are placed in concrete ducts, it is a good plan to provide them with cast-iron or structural steel frames, to make sure that they operate freely and are more nearly air tight when closed.

The drawings for this article were made up specially in a simplified form, but the various schemes shown are all taken from actual installations. While ideal conditions can seldom be obtained in any power plant, a careful study of the situation will always result in improved layouts, with consequently better operating conditions.

Thought and Work

IT IS not best for us to do our work in exactly the same way day after day. At least, we should think of new ways, for new thought means new vigor and new life. To think over the same thoughts and do the same things in the same way continually, makes us mere machine beings and not human beings. New thought begets new ways of doing work, and with both working hand in hand, we have progress, achievement, success.

N. G. NEAR.

Foundation Anchor Bolts for Machinery--VI.

TYPES OF BOLTS USED FOR THE SMALLER CLASS OF MACHINERY AND FOR FUTURE INSTALLATIONS. BY TERRELL CROFT

WEDGE anchor bolts have been used to some extent for fastening small machines to existing foundations where no provision was originally made for anchor bolts. These are applied only where the foundation is very shallow, and where sufficient strength cannot be obtained by cementing in a bolt. Figure 1 shows one of these bolts, the dimensions for which are given in Table I, and indicates the method of installation. These bolts are particularly useful where they must be set in a capstone of granite or hard lime stone. The hole for each one of the bolts is cut in the masonry, as shown in Fig. 1 with a stone mason's chisel, being wedge shaped, with a rectangular opening at the top which will admit the wedge-shaped end of the bolt when

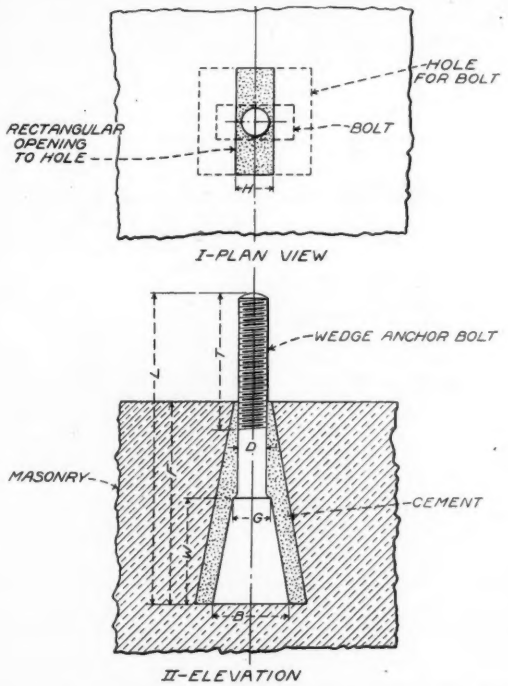


FIG. 1. PLAN AND ELEVATION OF WEDGE ANCHOR BOLT

it is turned into the proper position. After the bolt is inserted in the hole, it is twisted until the wedge surfaces of its enlarged end are parallel with the slanting sides of the hole. Then, cement or sulphur is poured around the bolt into the hole, completely filling it. It is claimed that where a bolt is installed in this way, if the proportions of the bolt are about those indicated in Table I, it will develop its full strength before it can be withdrawn by a tensile stress.

STIRRUP ANCHOR BOLTS

THESE ARE in reality merely a type of deformed bolts, Fig. 2, and they can be used to good advantage under the same conditions as those for which deformed bolts are suitable. A bar anchor can, however, be placed through the eyes of a series of stirrup bolts that are in line, which increases the resistance to withdrawal of every bolt in the series. Furthermore, the bar lying in the eyes of the bolts maintains their lower ends in line and tends to keep all of the bolts in a vertical position as they hang from their template while the concrete is being poured. The bar running through the eyes may be of round or square iron, or a length of wrought iron pipe.

EXPANSION ANCHORS

THESE ARE sometimes used where they will not be subjected to severe stresses, as shown in Fig. 3, to secure a machine bedplate to existing masonry. An expansion

TABLE I. DIMENSIONS OF WEDGE ANCHOR BOLTS

D NOMINAL DIA. OF BOLT	L OVERALL LENGTH	F MINIMUM LENGTH IN FOUNDATION	T LENGTH OF THREAD	W LENGTH OF WEDGE	B BASE OF WEDGE	G TOP OF WEDGE	H THICKNESS OF WEDGE
½	AS REQUIRED	5	1⅜	2¼	1½	⅝	⅜
⅝		6	1⅝	2½	1⅝	¾	⅜
¾		7	2¼	3	2⅛	⅞	⅜
⅞		8	2⅝	3⅜	2½	1	½
1		9	3	3⅝	3	1⅛	½
1¼		12	3¾	5	4	1⅝	½
1½		13½	4½	5¾	4½	1⅞	½

ALL DIMENSIONS ARE IN INCHES AND REFER TO FIG. 1

anchor consists, as shown in Fig. 4, of 2 shell shaped castings with threads on their inner surfaces so proportioned that a lag screw when it is turned into the shells which have been placed in the hole, will expand them and cause them to grip the sides of the hole. These anchors take a firm grip in soft masonry like brick work, but for concrete or hard stone the expansion bolts described later are preferable.

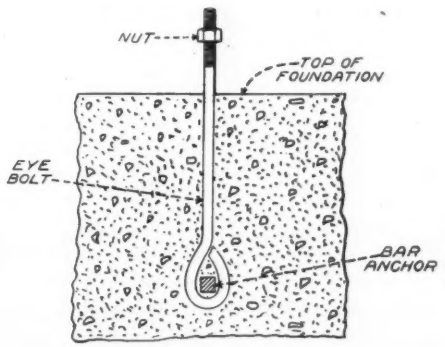


FIG. 2. EYE OR STIRRUP BOLT

Two sorts of expansion shields are on the market as shown in Fig. 4 at II and III. That of II will engage accurately coach or lag screws of only one pitch. Inasmuch as the various manufacturers of coach and lag screws have in some cases adopted different pitches (that is, number of threads per inch) for the same diameter of screw, shields made like that of Fig. 4, II, cannot be depended upon to fit any lag screws that may

be purchased; but, if shields like that shown at III are used, lag screws of any pitch ordinarily used will engage them. It is desirable, therefore, in purchasing expansion shields always to buy those of the type indicated at III.

Expansion bolts, Fig. 5, are used for conditions similar to those for which expansion anchors may be applied, but the expansion bolts appear to hold better in hard masonry. If these bolts are of sufficient length and properly installed, they will sustain static loads. They cannot, as a rule, be depended upon to sustain vibrating loads. A hole of a diameter just sufficient to admit the anchor of the bolt is drilled in the masonry, and the anchor inserted in the hole. Then the bedplate of the machine is placed over the hole so that the bolt hole in the bedplate and the anchor hole in the masonry are in line, and the bolt is turned down into the anchor and as it is twisted a wedge-shaped nut is drawn up on the bolt. As the nut is drawn up, it thrusts the 2 shields of the anchor apart, as shown at II, Fig. 5. A small circular spring normally holds the 2 shields of the anchor together.

In the single expansion type, Fig. 5, I and II, only the lower ends of the shields of the anchor are thrown apart as the bolt is turned into it, but with the double expansion type, Fig. 5, III and IV, the 2 shields are

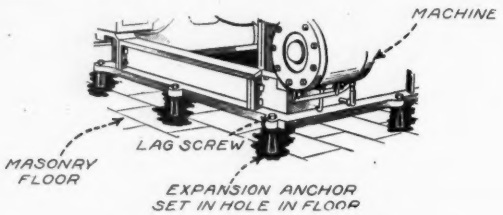


FIG. 3. EXPANSION ANCHORS

thrust apart equally at their tops and bottoms, so that they always lie approximately parallel with one another, and thus secure a better grip. The double bolts are used particularly for brick and cement and are approved by the U. S. Government engineers. The wedge used on any of these expansion bolts is pear-shaped and has in it notches into which projections on the shields engage; which prevents the parts of the shields from becoming separated and lost, and maintains the nut in position while the bolt is catching its thread. The diameter of an expansion bolt is understood to be the diameter of the bolt itself and not the diameter of the outside of the shield or of the expansion parts.

The length of bolt required for any particular installation may be ascertained by adding together:

(1) The thickness of the bedplate.
(2) The thickness of the grout.
(3) The length of the shield.

The standard lengths of these shields for the different diameter bolts will be found in manufacturers' catalogs.

Holding power of expansion anchors and expansion shields is a quantity difficult to determine definitely because, to a great extent, the method of installation determines this. If maximum strength is to be attained, the hole for an anchor or shield should always be of such a diameter that it will just receive the shield. That is, it should be necesary to drive the shields into the hole with light taps of a hammer; furthermore, if possible, the hole should be slightly larger diameter at the inner end than at the outer end. Then, if a bolt of the proper length is used and the bolt is screwed up tight, experience has indicated that in weak masonry like brick work, the masonry will pull out before the bolt will break or be withdrawn. In ordinary stone masonry such as field stone, the shield being set in the stone, and not in the mortar or cement, and properly imbedded as above suggested, the weakest member will probably be the nut in the bolt. The threads on the nuts are apt to strip if tension is applied to the head of the bolt until it fails. The same condition, of course, obtains in the case of very hard stone, such as granite. It frequently occurs, however, that such an expansion bolt, anchor and all, will pull out of a hole in hard stone before the threads strip, due to an improper setting of the bolt.

Flush Bolt-Anchors

It is sometimes desirable, during construction of a structure, to arrange for the installation at some future time, of foundation anchor bolts for a light machine.

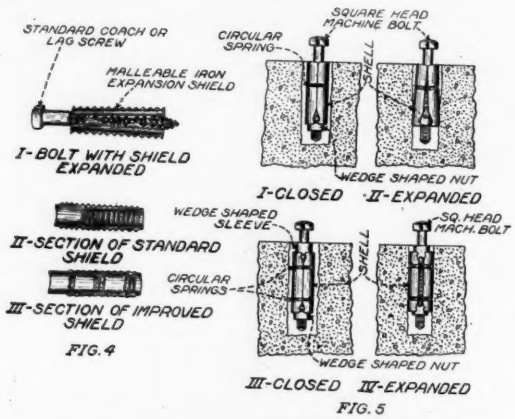


FIG. 4. DETAILS OF EXPANSION ANCHORS
FIG. 5. TYPES OF MACHINE EXPANSION BOLTS

Often an additional requirement is that nothing can in the meantime extend above the surface of the masonry or foundation top. If ordinary unpocketed anchor bolts are set in such a foundation, their ends must project above the surface and may be the cause of accidents or delays due to the fact that persons are apt to trip on them, and that if machinery is to be moved it must be raised before it can be skidded over them. Furthermore, the projecting ends of such bolts are frequently bent if the machinery is not installed promptly, or their threads may become battered, rendering them useless. Unless pockets are provided at the lower ends of the bolts, their replacement is extremely difficult and expensive.

Flush bolt-anchors are used in these cases. That of Fig. 6, shown in perspective at I and installed in a foundation at II, is used for light machines. The anchor is merely a casting, with an extended base and a threaded hole in its center. The anchors are located in the concrete of the foundation during construction and at any future time the machine can be clamped to them by inserting the bolts.

As shown at Fig. 6, II, some of these commercial anchors are drilled and threaded to accommodate bolts of different sizes, so that one size of anchor can be used for bolts of 2 or 3 different diameters.

The anchor of Fig. 7, used for more severe applications, can be procured on the market to accommodate bolts of diameters up to 2 in., and consists of 3 parts, the top casting, the cylindrical casing and the bottom casting. The cylindrical casing is merely a piece of wrought iron pipe or similar material so that the complete anchor can be made as short or as long as is necessary to satisfy existing conditions. This anchor is assembled and set in the concrete with a bolt temporarily screwed into it to hold it together while the concrete is being poured. After the concrete sets, the bolt can be removed and the open hole at the top of the anchor plugged with a stud until the time when it is desired to install the machine over the anchors.

A home-made flush anchor can be arranged as shown in Fig. 8, from an ordinary machine bolt, with an anchor of plate metal supported on its head, and turned into a sleeve coupling. This sleeve coupling can be made of machine steel and should have a length at least 4 times the diameter of the bolt with which it is to be used. In setting it in the concrete the bolt associated with the anchor plate is turned midway up into the coupling, which leaves the threaded upper half of the coupling ready for the accommodation of a stud bolt when the machine is installed.

attachment to them with lag screws, regardless of the locations of the bolt holes in the machine that will ultimately be placed. The holding power of lag screws of certain sizes are shown in Table II. These values are for bolts recently installed and one could not expect

TABLE II. HOLDING STRENGTH OF LAG SCREWS

KIND OF WOOD	DIA OR SIZE OF SCREW IN.	DIA. HOLE BORED IN.	LENGTH OF SCREW IN WOOD	MAXIMUM RESISTANCE LB.	NO. OF TESTS MADE
SEASONED WHITE OAK	3/8	1/2	4 1/2	6037	3
" " "	5/16	7/16	3	6480	1
" " "	1/2	3/8	4 1/2	6780	2
YELLOW PINE	3/8	1/2	4	3800	2
WHITE CEDAR-UNSEASONED	3/8	1/2	4	3405	2

values as great for bolts that had been in the wood for some time, particularly if the machine that they carried was subject to vibration.

Nuts for Anchor Bolts

These may be either square or hexagonal, of standard dimensions for the United States. At the lower ends of anchor bolts it is the practice to use square nuts particularly if the nut is to be retained in the cavity of a recessed anchor plate, because a square nut, with its longer edge, cannot turn readily in a properly proportioned cavity in an anchor plate, whereas a hexagonal nut might turn in its cavity if the casting were slightly distorted.

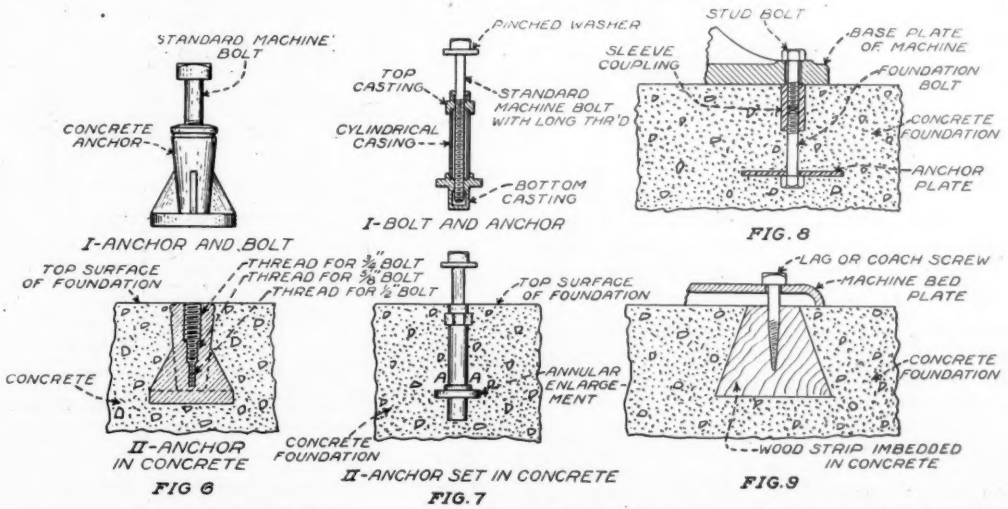


FIG. 6. FLUSH BOLT ANCHORS
FIG. 7. MOORING ANCHOR FOR CONCRETE
FIG. 8. SLEEVE COUPLING FOR NON-EXTENDING FOUNDATION BOLT
FIG. 9. LAG SCREW FOR HOLDING SMALL MACHINE

Lag screws are sometimes used for supporting machinery, wooden cleats being provided, into which the lag screws should engage, Fig. 9. While this method may give good service for holding steady running machines, it cannot be depended upon if the device is subject to vibration, which will soon loosen a lag screw and thus render the attachment insecure. In constructing concrete buildings where it is impossible to predetermine the locations of the anchor bolts for machines, strips of wood of a wedge section are inserted in the concrete during construction as shown in Fig. 9, so placed that it will probably be possible to effect an

On the other hand, the nut at the top of an anchor bolt which bears down on the machine bedplate should, as a rule, be hexagonal, first because it is neater in appearance, second because a hexagonal nut is more "get-at-able," that is, there are 6 possible positions in which a wrench can engage a hexagonal nut, whereas with a square nut there are only 4, a consideration which may be of particular importance where space is restricted. In installations where appearance is a factor, polished nuts can be used. Where the nuts will be manipulated frequently they should be casehardened.

(To be continued.)

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Watthour Meters*

MERCURY-MOTOR METER; INDUCTION METERS; ADJUSTMENTS; POLYPHASE METERS; TEMPERATURE EFFECTS. BY O. H. HENSCHEL

IN ORDER to understand fully the underlying principle of operation of this type of meter, refer to Fig. 4, where is shown disk *D*, capable of revolving between the poles of permanent magnet *M*. *B* and B^1 are brushes bearing lightly upon disk *D* and shaft *S*. If current be allowed to flow from brush *B* through disk *D* to shaft *S* and out at brush B^1, a torque is developed, due to the reaction between the current and the magnetic flux from the permanent magnet, causing the disk to rotate in the direction of arrow *R*. The torque acting on the disk is proportional to the value of current, the field strength remaining constant; or if both field strength and current change, the torque is proportional to their product.

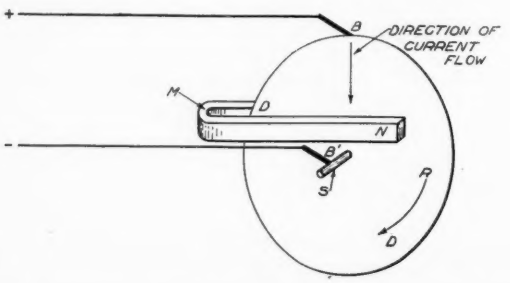


FIG. 4. CURRENT PASSING THROUGH DISK BETWEEN POLES OF PERMANENT MAGNET DEVELOPS TORQUE, CAUSING DISK TO REVOLVE IN DIRECTION OF ARROW R

Figure 5 shows diagrammatically the application of this principle in the connections of a mercury meter of the continuous-current type. A solid copper disk, *D*, floats in mercury contained in chamber *C*; *F* is a float supporting the shaft, thus eliminating the use of a lower jewel bearing; *H* is a laminated iron core.

Flux produced in core *H*, by the current in the shunt coil, *S C*, traverses the disk at 2 points which are diametrically opposite. The line current passes from *L* to L_1 through the mercury and diametrically through the disk. This disk being cut by the flux passing through core *H*, results in the production of a torque, which, being due to the line current flowing through the disk and the flux produced in core *H* by the current in shunt coil *S C*, is proportional to the product of current and electromotive force, or the power.

*Continued from page 1044, Nov. 15 issue.

When used on alternating-current circuits, this meter operates on the same fundamental principle as when used as a direct-current instrument, although the relative functions of the armature and field are reversed from those of the latter type. The laminated field magnet in the alternating-current meter is energized by a winding in series with the load and the armature circuit or the circuit through the mercury chamber, carries a large volume of current delivered by the secondary of a small potential transformer located inside of the meter casing, the primary being connected across the line. These 2 circuits then produce fields in phase, at unity power factor, varying with the current and voltage of

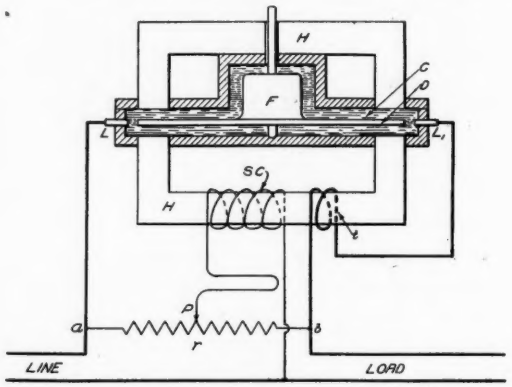


FIG. 5. DIAGRAM OF CONNECTIONS OF DIRECT-CURRENT MERCURY METER

the circuit, the result being that a torque is produced proportional to the power measured.

In Fig. 6 is shown the diagram of connections of this type of meter; the aluminum damping disk, *D*, and magnets, *MM*, constituting the damping element, and the motor element consists of the copper disk, *A*, float *F*, terminals *EE*, field magnet *Y*, field coils *FC*, and laminated punchings *P*. Small transformer *N* consists of a stick of iron punchings upon which are wound the primary coil *PT*, secondary coil *MS*, and auxiliary secondary coil *AS*. *RR* and *K* are respectively a high resistance rod and slider. There is induced in auxiliary secondary *AS* by the field produced by the primary winding, *PT*, a low potential, which when connected to coil *J* is sufficient to force enough current through the circuit to produce a field to overcome the friction of

the instrument. By adjusting slider *K*, this current and field can be varied at will, allowing proper compensation for any possible friction.

Induction Meters

Induction type of watthour meters operates on the principle of the rotating magnetic field of the induction motor. A thin disk or cup of copper or aluminum, generally used as motor, and generator element, is mounted on a delicately pivoted spindle and driven by an electromagnet device at a speed proportional to the power delivered to the receiving circuit. The essential features of this magnetic device which, of course, are more or less modified in the various makes of meters on the market are shown in Fig. 7. Disk *DD* rotates in front of 3 magnet poles of a laminated iron structure, the lugs of which are wound with coarse-wire coils *S*

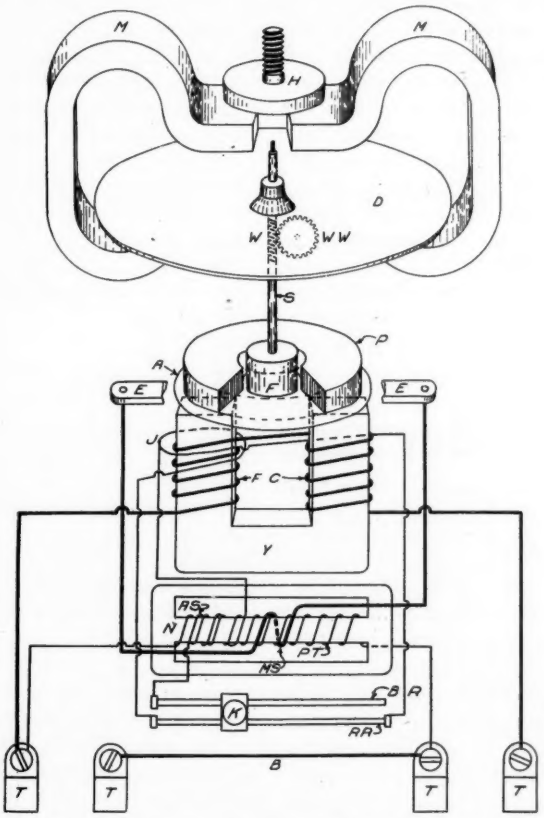


FIG. 6. DIAGRAM OF CONNECTIONS OF ALTERNATING-CURRENT MERCURY METER

carrying the total current delivered to the receiving circuit and fine-wire coil *P* connected directly across the line. *C* is a compensating coil, the function of which will be explained in full in a following paragraph. The alternating magnetic fluxes from the poles establish currents in the disk as indicated by the arrows. Potential winding *P* with its many turns of fine wire is highly inductive, while the series windings *S* are of heavy wire of comparatively few turns, and as a result are practically noninductive. As a consequence, the fluxes produced by the potential and current circuits are approximately 90 degrees apart. Each flux is in phase with the current producing it, and the electromotive force generated in the disk which is cut by the flux is in time quadrature with the generating flux. If it is assumed, therefore, that the fluxes produced by coils *P* and *S* are in quadrature, the eddy currents produced by *P* will be maximum at the same instant that the flux from *S* is a maximum, and vice-versa. As a result, a torque will be produced which is proportional to the instantaneous product of the eddy currents in the disk and the flux from the pole under which the current is flowing. With the time phase difference of the currents in coils *P* and *S* exactly at 90 deg. at unity power factor, this torque is proportional to the power used.

In order to have induction meters register correctly, it is necessary to have this time phase difference of the current in coils *P* and *S* exactly 90 deg. Due, however, to the ohmic resistance of winding *P*, this condition is never realized so that all induction type meters are provided with a short-circuited compensating coil mounted on pole *A* as shown in Fig. 7 and provided with a variable resistance *r*, so that by changing the value of *r*, the meter may be made to indicate correctly on both inductive and noninductive loads. This same result may also be accomplished by changing the reluctance of the pressure circuit.

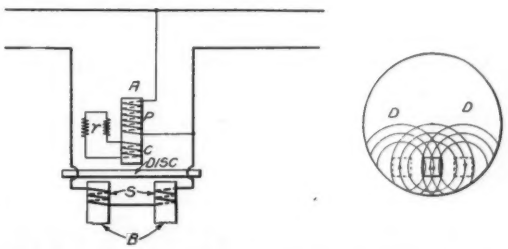


FIG. 7. ESSENTIAL FEATURES OF ALTERNATING-CURRENT INDUCTION WATT-HOUR METERS

While induction meters are not entirely free from friction, some compensation must be provided to overcome this, so that the meter may read correctly on light loads. This is generally accomplished by producing a flux at the potential pole face, slightly out of phase with the main flux. Thus eddy currents will be produced in the disk which will be in phase with a small component of the main flux, giving rise to a slight torque, which can be made sufficient to overcome the friction. A common method to produce this out-of-phase flux is to place a short-circuited copper circuit or thin copper punching in the potential pole air gap, in an unsymmetrical position, so that the desired unbalanced flux may be obtained.

Adjustment

Like direct-current commutator meters, the speed of induction type meters may be varied by changing the position of the damping magnets relative to the disk or cup. When disks are employed, the speed for a given load may be increased by changing the position of the magnets so that the effective flux will act nearer the shaft. Swinging the magnets out and thereby causing the flux to cut the disk at a greater distance from the shaft will result in a greater drag on the disk with a consequent reduction of speed. The speed of meters provided with cups may be varied by raising or lower-

ing the damping magnets. When lowered, the path of the magnetic flux of these magnets is shunted to some extent by the air gap between poles and less flux is allowed to act upon the cup, thereby increasing the speed of the revolving element. Raising the magnet, however, results in more flux acting on the cup with an attendant slowing down. The position of the light-load compensating coil may be changed by conveniently located screws and the light-load speed thus altered.

Polyphase Watthour Induction Meters

Polyphase watthour induction meters consist of 2 or more elements and one or more generator elements all mounted on a common shaft. The operation of the motor elements should be such that their combined torque for a given power will be the same on both balanced and unbalanced loads.

Temperature Effects

Change of temperature affects the performance of meters by changing the resistance of the potential circuit, changing the resistance of the disk or cup and by changing the strength of the damping magnets. These changes produce a combined or resultant effect which is compensated by using for the series resistance in the potential circuit, one or more materials so combined that the final temperature coefficient of resistance counteracts the other effects when the air temperature changes.

In a recent issue of the Electrical World, B. E. Miller reports the results of a series of experiments conducted in the electrical-engineering department of the University of Wisconsin to determine the effect of temperature on the accuracy of watthour meters. All of the 5 meters tested were adjusted to read accurately at 70 deg. F., after which they were subjected to temperatures varying from 20 deg. F. below zero to 140 deg. F. above zero, and tested at 150, 100, 50 and 10 per cent of full rated capacity at various temperatures. Mr. Miller states that within the range of temperatures employed, the tests seemed to show variations of registration of 3, 5 and even 7 per cent from the original calibration, the widest discrepancies being observed under temperatures corresponding to winter conditions.

These variations in accuracy may be due wholly or in part to any one of the following effects; change in friction, change in electrical resistance of the rotor, change in electrical resistance of voltage coils or change in reluctance of the magnetic circuit. As the temperature decreases, friction of the moving part increases on acount of shrinking and warping of the frame and bearings and thickening of the lubricants. The electrical resistance of the rotor increases with increase of temperature. This would cause a decrease in eddy currents in the disk under the brake magnets, but there would also be a decrease in currents induced in the rotor by the driving magnets, resulting in a decrease of driving torque. In a similar manner, the resistance of the voltage coils increases with increase in temperature. The reluctance of the magnetic circuit may be due to a change in permeability of the iron with temperature or to change in the dimension of the air gap.

(To be continued.)

High Voltage Trolley Line

Short Description of the Experimental Line of the Michigan Traction Co. By Clarence Renshaw

IN the use of direct current for electric railways, the trolley voltage of 600, so long considered the limit, has, during the past few years been increased to 1200 and then to 1500 v. The lines where this was first done operated with such universal success that these voltages quickly became common and are now established as standards for interurban work. So few were the difficulties experienced in building and operating apparatus for 1200 and 1500 v., and so similar to those for 600-v. apparatus were the requirements found to be, that the probable success of further increases in voltage was quickly foreseen so that the increasing interest in this branch of the art led to several installations at 2400 v. The next step on a commercial basis was the electrification of the Chicago, Milwaukee & St. Paul Railway, which will use a trolley voltage of 3000. Even this voltage, while it will no doubt give excellent results in the case at hand, is not sufficiently high to eliminate current collection from among the serious problems in the design of large locomotives as is done by the use of 11,000 v. alternating current or to hold the number of substances and the cost of line copper within the desired bounds. With direct-current railway apparatus at this stage of its development, it appeared to the engineers studying the situation that railway apparatus for 5000 v. direct current might be entirely feasible.

As a result of this gradual increase of trolley voltage, a section of the lines of the Michigan United Traction Co. from Jackson to Grass Lake, 11.4 miles in length, has, as an experiment, been equipped to run a 5000-v. car.

In revising the 600-v. trolley line for use on 5000 v., the construction was modified by removing the usual 600-v. insulator and replacing it by a type PG porcelain strain insulator located in the span wire at each side. This simple and inexpensive arrangement has been remarkably satisfactory and has not given a minute's trouble during the 3½ months the line has been in use.

The 5000-v. trolley is separated from the 500-v. one at the outskirts of Jackson, by an insulated section of slightly greater length than the car. This is normally dead, but by holding a long rope attached to an air-break switch on an adjacent pole, it can be energized with 5000-v. current. When the car is coming from the 500-v. line, it is stopped on the dead section until the changeover switch has been thrown. By holding the rope, the section is then energized with 5000-v. power until the car has left it, after which the rope is released and the section again becomes dead. When the car is coming from the 5000-v. line, it coasts entirely over the insulated section to the 500-v. line and the changeover switch is then placed in the 500-v. position.

The Substation

Direct-current power at 5000 v. for operating the car is obtained from steel-tank, mercury vapor converters located in the substation at Grass Lake, which supplies 600-v. power for the normal operation of this line and a neighboring line of the Detroit United Railways. Three of these converters, with their alternating-current terminals connected one set to each phase of the 400-v., 3-phase, 60-cycle bus bars of the station and their direct-current terminals connected in series as shown in Fig. 1, are used for normal operation with a fourth installed as a spare unit.

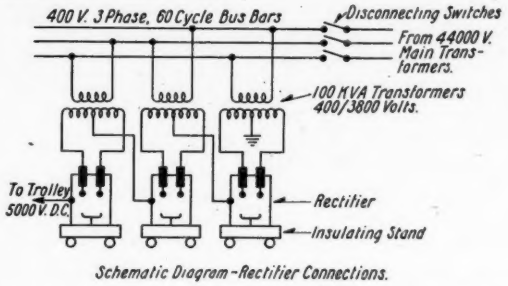

400 V. 3 Phase, 60 Cycle Bus Bars
Disconnecting Switches
From 44000 V. Main Transformers.
100 K.V.A. Transformers 400/3800 Volts.
To Trolley 5000 V. D.C.
Rectifier
Insulating Stand
Schematic Diagram - Rectifier Connections.

FIG. 1. DIAGRAM SHOWING CONNECTIONS OF VAPOR CONVERTERS FOR 5000-V. DIRECT-CURRENT TROLLEY LINE

The use of vapor converters for supplying power is in no way an essential part of the test for the 5000-v. equipment, but is an entirely separate experiment.

The Car

The most interesting and important items of the installation are, of course, the car and its equipment. This is a standard wooden interurban car, approximately 56 ft. long, over all, and 30 ft. 9 in. between bolster centers, weighing 40 tons without load. Its equipment consists of 4 motors, each rated at 100 hp., 2400 v., connected 2 in series for operating on 5000 v., together with a suitable outfit of unit-switch control. Operation in the city of Jackson is provided for by a changeover switch which re-groups the motors for the service.

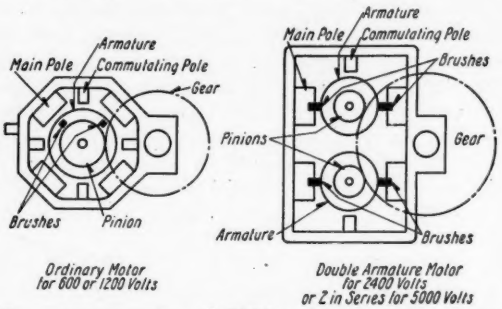


FIG. 2. CONSTRUCTION OF 5000-V. DIRECT-CURRENT MOTOR COMPARED WITH THAT OF ORDINARY MOTORS

The use of so high a voltage as 2500 at the terminals of each motor is made possible by the fact that the motors are of the double-armature type, each field frame containing 2 entirely separate armatures with independent pinions which are connected together by meshing with a common gear. While the voltage at the terminals of a motor is 2500, that on any one commutator is limited to 1250.

This principle, perhaps, will be more clearly understood by reference to the sketches, Fig. 2, where the arrangement of this type of motor as compared to the usual 600 or 1200-v. railway motor is shown in diagrammatic form. The appearance of the actual motor from the pinion end is shown by the photograph, Fig. 3. While this motor looks extremely deep as compared to

FIG. 3. 100-HP. 5000-V. DIRECT-CURRENT MOTOR

the more nearly circular forms in general use, there was no difficulty in mounting it on 37-in. wheels with entirely satisfactory clearance. Access to the upper brushes is obtained by the usual commutator lid at the top of the motor, while the lower ones may easily be reached from a pit through a similar opening at the bottom.

Control

Opening and closing of the 5000-v. circuit is accomplished by switches of the double-break type, so that a large number of circuit-opening breaks in series is obtained with a comparatively small number of switches.

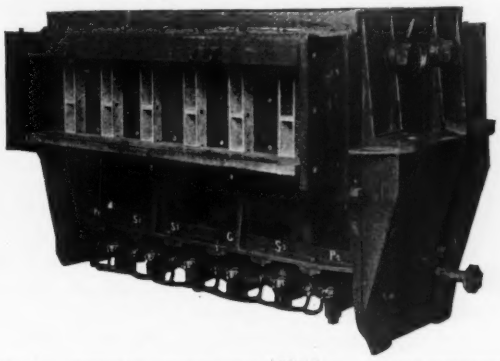


FIG. 4. SWITCH GROUP FOR 5000-V. DIRECT-CURRENT SERVICE, WITH COVERS REMOVED

One of the 2 6-switch groups of these switches which are employed on the car is shown, with covers removed, in the photograph, Fig. 4. Certain additional switches which are never subjected to high voltage, are of the ordinary 600-v. type.

Power for operating the air compressor, arc headlight, car lights and control circuits is obtained from a 150 v. storage battery, which is charged by being connected in series with the motors during 5000-v. operation and by being connected to the trolley through a resistance during 500 v. operation. The battery is protected from the action of heavy peak loads by a set of counter E.M.F. cells connected in parallel with it. These

act as a safety valve and shunt off some of the motor current from the battery in case this exceeds the safe capacity of the latter. Experience has proven that in the case of this equipment the battery is of such ample size that the counter E.M.F. cells are really not necessary and could be omitted.

Overload protection is afforded, as is usual with equipments of unit-switch control, by an overload trip relay, which, on being operated, causes all of the main circuit breaking switches of equipment to open and thus cut off power. The changeover switch for modifying the connection for 500 v. operation is of the oil insulated type, and is manually operated by a suitable lever at the side of the car. The trolleys are of the ordinary wheel type, each mounted on a suitable insulated base. Protection in handling the trolleys is afforded by a long wooden insulator inserted in each of the ropes. The reverser, resistance, master controllers, control switches, etc., are of the usual type and require no particular comments.

While it might be expected that in handling current at so high a voltage excessive arcing would result, it has been found that on account of the extremely small currents required and the greater number of brakes in series, the results are just the opposite. With the covers of the switch groups removed, the car locked by the brakes, and the control thrown on and off, the arcing at the switches on this car with 5000 v. on the trolley is noticeably less than when a 600-v. car is handled in the same way.

An incidental effect of considerable interest is the operation of the car lights and auxiliary circuits from a storage battery, so that a brilliant uniform illumination is secured at all times. Until the crews became used to this feature, it sometimes led to amusing results on account of the trolley coming off the wire and the men not noticing it because the lights continued to burn.

Synchronous Motor Trouble

By A. Thomson

IN A large paper mill, where telautographs are operated by current supplied by an exciter directly connected to a synchronous motor, trouble with illegible writing was experienced after 3 months of otherwise satisfactory service. The mill machinery is driven by 440-v. induction motors, current being generated by 2 direct-connected alternators. The synchronous motor in question is used for power-factor correction and drives a direct-current generator in adddition to its exciter.

The electrical engineer who was called in to locate the trouble, discovered that the armature of the synchronous motor was swinging back and forth in step with the alternator that was in use at the time, and that the hum of the motor fields changed in time with the stroke of the engine. A voltmeter connected across the brush-holders of the exciter showed a slight variation in voltage, which, even though but about 1 v., was causing all the trouble.

The second alternator was put on the board and the first one disconnected. As soon as this change was made, all trouble stopped, and the motor current dropped from 40 to 10 amp. With the motor working well on one alternator, it was evident that the motor was not at fault. An examination of the first alternator showed it to be in first class condition, so that the trouble was looked for in the engine. The log showed that this had been overhauled and the valves reset at a time the steam pressure carried was 80 lb. with a maximum load of 50 amp. Since then, however, the working pressure has been raised to 120 lb., and the load increased to 200 amp. The engine was indicated at full load and found to be cutting off at ⅔ stroke on the head end and about 1/6 stroke on the crank end. Engineers who have set the valves on high-speed 4-valve engines know that they must be set for the average load at correct pressure, as the distribution of steam changes with the load.

After resetting the valves, the motor and alternator went to work again without any indication of trouble. This was unquestionably a case of hunting between the alternator, due to a variation of its angular velocity, and the synchronous motor.

The conditions causing hunting between 2 alternators are similar to those between an alternator and a synchronous motor and as the former are much easier to present, that will be used in a brief explanation of the theory of hunting.

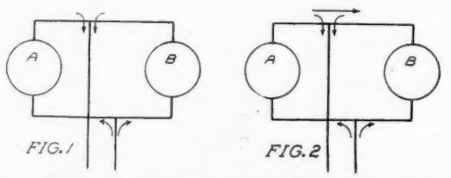


FIG. 1. DIRECTION OF INSTANTANEOUS CURRENT FLOW WITHOUT CIRCULATING CURRENTS

FIG. 2. DIRECTION OF INSTANTANEOUS CURRENT FLOW WITH CIRCULATING CURRENTS

When 2 alternators are operating properly in parallel, the current flows as shown in Fig. 1, the electromotive forces are equal and opposite with respect to the closed circuit of the 2 armatures and their leads, and there is, therefore, no current circulating between them. If one of the machines, say B, should slow down, the current would then flow as shown in Fig. 2. The 2 electromotive forces are then no longer exactly opposite and a circulating current flows between the 2 armatures. While this current does not exist separately, being a part of the current supplied by each armature, it is convenient to consider its effect separately. It may be seen from Fig. 2 that this circulating current is in the same direction as the electromotive force of A, therefore acting as an additional load on A, causing it to slow down, and being opposed to the electromotive force of B it lightens B's load, causing it to speed up. The 2 machines then tend to come together as shown in Fig. 1, when they are in step and no circulating current exists. Due, however, to the weight of the machines, they will swing beyond the no-circulating current position and produce a circulating current flow in the opposite direction. The frequency of this swing is called the natural vibration of the machines. If the machines are direct-connected to engines as in this case, whose angular velocity is variable, forced oscillations will be impressed on the machines; if their period of vibration is within

20 per cent of the natural vibration of the machines, cumulative swinging will be produced and the machines thrown out of step and shut down unless powerful dampers are used.

The magnetic flux in the field or stator produced by the direct current winding is practically constant in value. During hunting, however, the flux is driven back and forth across the pole face in time with the hunting. This shifting of the magnetic flux is due to a change in the relative position of the revolving field of the alternating-current winding and the geometric center of the direct current field pole. If, therefore, a low-resistance closed-circuit winding is placed around the pole or embedded in the pole-face, current will be induced in this closed circuit by the shifting of the main field. This induced current, in turn, produces a field which will prevent or oppose the shifting of the main field, thereby assisting in the overcoming of hunting.

If there is an ammeter on the bus-bars, its reading should be the sum of the readings of the individual ammeters in which case there is no hunting; but if its reading is less than the sum of the separate meters, the difference is the value of the circulating current between the alternators, holding them in step.

Petroleum As Fuel*

PROPERTIES; METHOD OF HANDLING; ADVANTAGES; FURNACES. BY W. N. BEST

CRUDE OIL is of 2 kinds, paraffin base and asphaltum base, and varies from 11 to 46 gravity Baume. The light-gravity oil does not require heating before use; but oil of less than 20 gravity Baume should be heated to just below its vaporizing point, in order to reduce its viscosity and to obtain the highest efficiency of combustion. Heavy California oil vaporizes at 230 deg. F., Mexican crude oil at from 175 deg. to 210 deg. F., and Beaumont, Texas, oil at 142 deg. F. Fuel oil vaporizes at 130 deg. F.

The burning of oil is an art based on science, and the "rule of thumb" should never be employed, especially in heating heavy crude oil. Thermometers should be used on both suction and supply pipes so that the fireman will at all times know the temperature of the fuel. The indicators on such thermometers should be large enough to be readily seen by the operator, night or day.

It is necessary to have an unvarying pressure of steam or air through the burner, to atomize the fuel. Also, the air used to support combustion should be delivered through a nozzle under the burner at a constant pressure. The oil pressure must not fluctuate; under no circumstances should it vary more than 1 lb. The oil pump, which should be brass lined, with the aid of the pulsometer and superheater, will insure a constant circulation of fuel to the various burners, maintaining an unvarying pressure on the supply pipes. All oil pipes should be of adequate size and carefully laid.

A non-carbonizing burner of modern construction, that will externally atomize the fuel and distribute the heat over the entire width and length of the furnace or firebox, should be used. If steam is used through the burner to atomize the oil, it should be taken from the top or dome of the boiler or superheater so that it will be as dry as possible. The atomizer orifice in the burner should be as small as practicable to provide for the minimum and maximum capacity of the burner.

*From a paper read before the Am. Inst. of Mining Engineers.

COMBUSTION CHAMBER

THE FUNCTION of a combustion chamber is to provide space in which the atomized fuel may unite with sufficient air for combustion before it reaches the furnace proper. In the more modern furnace practice only a sufficient amount of steam or air is forced through the burner to atomize and distribute the oil, while the remainder (ordinarily about 19-20 per cent) of the air necessary for combustion is delivered at from 2 to 3 oz. pressure through a nozzle, often located below the burner, and provided with a sliding gate, so that the quantity of air entering the combustion chamber is readily controlled by the operator. It is necessary that the flame made by the burner shall fit the combustion chamber perfectly, so that the total volume of air delivered into the chamber will pass through the flame.

BOILER SERVICE

THE USE of coal involves the handling of coal and ashes, the employment of additional firemen, etc., all of which is avoided by the use of oil. When, in view of this saving, the price of oil compares favorably with that of coal, the former is highly preferable on other grounds also. It is clean, simple and cheap in operation; and since it requires accurate control, it utilizes and trains the judgment of the fireman, and thus elevates the character of the labor employed.

In the equipment of locomotive, marine, and stationary boilers, the first consideration is the protection of the metal constituting the elements of the boiler. This can be effectively accomplished at a small cost.

As soon as a locomotive is changed from coal to oil fuel (which can be done at a very small cost), the train-tonnage of the engine is increased 15 per cent, because the locomotive can easily carry the steam pressure at all times at just below its "popping-off" point. This, of course, cannot be done while using coal as fuel.

For locomotive service the most modern practice is "the duplex oil system," which employs 2 burners, a small and a large one. The former, used as the engine leaves the roundhouse and operated continuously thereafter, serves as a pilot light, as well as to keep just sufficient heat in the firebox to maintain the temperature and the steam required when the locomotive is standing still. It keeps the steam at just below the "popping-off" point when only the air pump is running, and no other work is being done. The large burner, ordinarily placed above the smaller one, is operated when the locomotive is at work. By this system the life of the boiler is increased, and the handling of the locomotive becomes much simpler. Gravity oil feed is ordinarily used in service. Air pressure should not be used on the locomotive oil tank to aid in forcing the fuel to the burner; but in stationary or marine practice 10 lb. pressure should be maintained on the oil-supply pipe.

In marine service oil, at the will of the fireman, readily increases the boiler capacity 50 per cent or more. The fuel tanks on the vessel can be filled in a few minutes, regardless of climatic conditions. There is no dust

or dirt—a great advantage, since the dust from coal, settling in the state-rooms and around other parts of the vessel, is very annoying on shipboard. In an emergency, when the vessel must be run at maximum speed, liquid fuel quickly responds to the demand for extra work.

For stationary boilers, especially in electric-light plants, where there may be a battery of "standby" boilers, the use of oil permits the boiler capacity to be easily doubled in an incredibly short time, without injury to the boilers. One man can fire and water-tend 12 300-hp. boilers.

Furnaces

Some years ago manufacturers often contracted for the complete installation of oil furnaces, but they have found it better policy to have their own masons construct the furnaces, purchasing designs and oil burners, etc., from well-known engineers in this particular line. Under this system, greater care is exercised in the construction of the furnace, for the local mason knows that any errors or defects in workmanship will be brought to his attention, and he will be held responsible for them. Manufacturers have found, moreover, that their own masons can construct the furnaces for 50 per cent less than any outside furnace manufacturer can afford to estimate.

Firebrick

The selection of firebrick should be carefully made and only the best quality used; for it requires as much time and labor to lay a bad brick as a good one. The brick should withstand the temperature required without dripping, disintegrating, or spalling. They must not be laid in a layer of fireclay, as is the practice with red brick, but simply dipped in a thin mixture of fireclay and water, before being placed in position in the walls or arch of the furnace. The fireclay should be purchased from the firm manufacturing the firebrick. If a different fireclay is used, it will not adhere so well to the brick, and furthermore, it will not fuse or bond with the surface of the latter.

Jeremiah Judson, C. E.

Honey Combed Casting Destroyed Vacuum

As usual, the bunch was sitting around the little sheet iron stove in the "second floor rear" that was the meeting place of the engineer's club, and one after another told of some remarkable occurrence in his own experience, till finally the subject turned to that peculiar phenomenon known as "Vacuum."

Some pretty tall ones were put over the plate, which were accepted with the proverbial grain of salt, till Cadwell told of running a plant down in Kenosh where he habitually carried a vacuum of 19 lb. and raised water from a depth of 36 ft.!

"Here, Cad," said Gunderson, as he reached after a make-believe belt, "you are entitled to the championship belt. It has been an "air"-loom in our family since the days of Ananias. Take it and welcome; no hard feelings, I assure you."

"Well, your talking about vacuum," said Jerry, as he banged his cavernous calabash on the stove hearth and carefully refilled it, "reminds me of a little experience that I had down at Arkansas City, Muzzouri. Our firm had the contract to build a little engine for the waterworks down there to be direct connected to a centrifugal pump which was intended to pump the water from the Big Muddy river up into the filter beds.

"The Clamshell Iron Works near Quakerville built the pump, an 8,000,000-gal. centrifugal low-duty high-speed affair. At the same time, they were building a 15,000,000-pump of the same type to be direct connected to a Russell engine in the Arkansas station. These 2 stations were about 400 ft. apart, but one pumped water for the Muzzouri half of the town and other for the Arkansas half of the town. The town was built on the state line.

"Well, as one engine was shipped ready to run, the man from the Iron Works put it on the sub-base containing the pump, and started up; but for some reason or other he didn't get it adjusted right and while it ran, it didn't run satisfactorily, so I was sent down there.

"I found Higson, the pump man, sort of dividing his time between the 2 plants so as to get both jobs running and off his hands as soon as possible. The pumps were set as low as possible to reduce the lift, ours being down in the basement where the temperature during those few days in August that I was there was never less than 118 deg. The pump room at the other plant was open at the top and was thus quite cool, comparatively.

"Just after Higson had gotten the big unit set up over at the other plant, and was ready to run, the Big Muddy took a notion to go on a rampage and backed up into the pit where the independent air pump was located, the surface condenser (on both pumps) being in the suction line. So when he got ready to try out the big unit most of the piping was under water and of course he had a beautiful vacuum—almost as much as Cad's.

"Well, when I arrived on the scene, of course Higson put in all of his time with me till we got one little unit pretty well cleaned up. In the meantime, the river went down, leaving the piping and air pump 'above high water mark,' over at the other plant. So, in the meantime, the high collars of the other half of the city came out to inspect the new engine and pump, and Higson, never suspecting trouble, went over and proceeded to put the Russell engine through its 'sprouts.'

"But try as he might and look as wise as he could, Higson could not coax that vacuum gage above about 12 in., and of course it made him look a little bad to the jewelers, shoe dealers, horse doctors, and dentists, that made up the aldermanic 'board of inspection.'

"After they had gone, not very enthusiastic over the trial, he came over to where I was doing a little adjusting on our engine, and he was worried clear through. He sat there on an empty box sweltering in a temperature of some 120 deg., chewing stogies by the foot and cussing gently, when he might just as well have been outside where it was only 98 in the shade, keeping cool.

"'But what gets my goat, Jerry,' he said at length, 'is that we got all kinds of vacuum before when I ran her, as much as you could get with condensing water at a temperature of 84 deg. And now when the brass collars are around, she won't pull up worth a cuss,' and he fell to cussing again. 'Come over when you get a chance and see if you can break the hoodoo,' saying which, he doggedly went back to the other plant.

"Well, I did go over the next forenoon. Higson was sitting on the edge of the pit looking at the mess of piping in the bottom. I also looked the outfit over, and suggested loose flanges, cracked flanges, split pipe, sand holes in elbows, and everything that I could think of that might have been the cause, but Higson had looked all over for these things and found them not.

"'How high was the water in the pit when the river was up?' I inquired.

"'Up to that ring of grease above the name on the air chamber of that pump,' replied Higson, pointing, and a continuation of the grease ring all around the wall of the pit bore him out. When sizing up this ring, I noticed a 2-in. valve opening into the pit, with hose connections on, which was evidently used to wash out the mud after a flood.

"Going down into the pit, I found a strainer over a drain in the floor, evidently leading to the sewer. This gave me an idea. 'Start her up and let's see her perform, Higson,' said I, and he started up; but when the vacuum gage registered 12 in., it wavered back and forth at every stroke of the pump, showing that there was a large air leak some place.

"I covered the strainer with a piece of rubber packing, and going 'on deck,' opened the 2-in. valve to flood the pit with water. This seemed like some superstitious stunt to Higson, judging by his looks. In about 25 min., the gage took a spasmodic spurt followed, at ever increasing intervals, by longer and more sustained ones as the wavy surface of the water rose a fraction of an inch a minute.

"Suddenly, the vacuum gage went steadily around to 24 in. and stayed there. 'Higson, I'll bet a million that you will find an air leak some place along the line of the surface of the water,' said I, and his frown changed to a smile. We borrowed hip boots and went down to investigate. We kicked the water around considerably all over the surface of the pit; but, as all of the piping was well submerged, it all pointed to the pump as the location of the leak.

"So we kicked around the pump and suddenly the gage dropped a few inches and went back to 24 again. This looked promising. With a stick I raised the rubber disk over the drain and let out water till the gage began to 'act up' continuously again. As the surface of the water was smooth, it stood to reason that the leak was on the same line.

"Higson took a candle and investigated and soon noted that the drops of paraffin floating on the water had an affinity for the pump at one particular place, and closer investigation revealed a little cluster around the boss where in a stud was screwed. I let out a little more water and we had the same old 12 in. Higson held the candle up to the suspicious place, and the flame seemed to dodge right into the iron, thus proving that here was the place.

"He let the melted wax run onto the spot and rubbed the plastic candle over the place, sealing the leak and the gage went up at once to 24. Higson looked at the spot, then at the gage, then at me, and said, 'Well, I'll be damned.' Draining out all the water and stopping the engine, he melted away the wax and soon was drilling a hole in the suction chamber and plugging it with a brass plug, well doped with red lead. The iron was honey-combed clear through about the diameter of your finger, and a half inch plug turned the trick.

"The engineer at the plant was satisfied with the outfit and at the same time was willing to put one over on the aldermanic gang. So when the 'all sufficient committee on water works' appeared again a few days later to inspect the outfit, she was running along merrily, pulling up 36 in. of vacuum by the doctored gage.

"'A-ha,' said a self important little real estate alderman, 'that's more like it. What was the difficulty the other day, Mr. Higson?'

"'Oh, nothing serious. I forgot to close the junk valve and part of the vacuum leaked out,' and, by gravy, boys, he got away with it."

"Well, square up against the wall there, you fellers, and take your hats off. We are going to hold meetin'," and Pres. Ellis brought the gavel down with a bang.

Freezing of Air Pipes in Winter

Some Pertinent Questions and Answers. By Frank Richards

THE following inquiry recently received should be of interest to others besides the writer:

"I have air traveling through a 4-in. pipe on the surface of the ground about 2000 ft. and I expect to work this winter. How can I prevent the air from freezing? Will glycerin dropped into the pipe, say ½ pt. per day, prevent it from freezing? Shall I cover it with box and manure? At what temperature is it likely to freeze? How much circulation must air have to prevent freezing?"

This is an interesting series of questions and all to the point, also pertinent to the approaching season. In replying, it should first be remarked that, as our correspondent of course knows, it is not the air that freezes and makes the trouble, but the water which the air carries, and not all of that. Atmospheric air normally always contains, intimately distributed through it, a variable proportion of water, and the ability to carry more and more, or to hold more securely what it already contains, comes with increase of temperature. When air is compressed with little or no cooling during the compressing operation, as it generally is even if the cylinders are water-jacketed, it is delivered at a considerably increased temperatures, and so long as the heated condition continues there can be no deposition of water, which is why water is not deposited in an air receiver located near the compressor.

As the air flows along through a pipe line, however, it cools very rapidly, and in a run of 2000 ft., as above, it would certainly be cooled nearly to the temperature of its surroundings. If the air has been compressed to a pressure of, say, 6 atmospheres, or 75 lb. gage pres-

sure, its capacity for moisture is reduced, for corresponding temperatures, to about 1/6 of that of the free air, with which it started; consequently, as it has flowed along through the pipe and has gradually cooled, it has been giving up its moisture to collect and flow along the bottom of the pipe.

Now, if it happened to be freezing weather and the pipe was cooled to below the freezing point, the water thus flowing within it would certainly freeze there, and keep on freezing layer upon layer, until the pipe might be completely choked by the accumulated ice. The only thing to do under these conditions is to protect the pipe so that its contents will not freeze. This, of course, may be done by covering it with sufficient protective material or by burying it in the ground to a sufficient depth, the same as a water pipe. Means should be provided for drawing off the water at low points; if there were alternating periods of freezing and thawing, the latter should be taken advantage of for draining, although the thawing would probably be slow after the ice was once formed.

It is good practice, and it will pay for itself in most cases, to provide an efficient aftercooler near the compressor, and in connection with that a separator to take care of the water; any good steam separator would do, and the latter, taking the air when it was at its highest pressure and at its lowest temperature, both conditions minimizing the capacity of the air for moisture, should leave little or no water to be carried along into the pipe line.

As to how much circulation the air must have to prevent freezing; this would have little to do with it, and the greater the volume of air the greater also would be the quantity of water carried by it and ready to be deposited and frozen if the other conditions concurred.

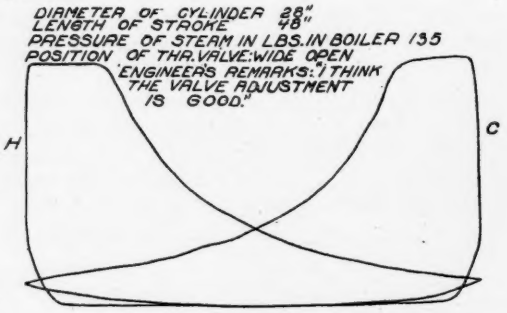
History of a Sawmill Engine

CHANGES WHICH ALTERED RELATIVE STRENGTH OF PARTS. BY H. H. WELBON

ON one of my travels I got the card shown here. A little of the history of this engine, the manner of how it was repaired and the money the firm spent for repairs which proved failures is interesting.

In the first place, the foreman seemed to have an idea that he knew about as much about engines as any engineer on the globe. The story I heard about this engine is as near like this as I can remember. About 3 yr. ago the engine knocked the head out of the cylinder and caused a delay of some little time and some one conceived the idea of putting on a 28 by 48-in. cylinder whereas the old one was 24 by 48, and they found the steam pressure too low for the work being done. So the firm bought 6 new 72-in. by 20-ft. Casey Hedges boilers in steel settings good for 135 lb. steam. On connecting in the steam line to the engine they put in a reducing valve to reduce this pressure back to 100 lb. Then the foreman came along and took out the gang saw and put in another band saw and the engine would not pull the load, then he took the reducing valve out and ran on 135 lb. of steam.

In the meantime the engine began to tear up the foundation, so they raised it off the foundation and put a sole plate under it about 1½ in. thick, which weighed about 12,000 lb., and the engine was started up, the next step was the danger of the crankpin shearing off, so a new crank shaft was ordered with a pin 7½ in. in diameter instead of 5½, which was the size of the old one. So a new connecting rod had to come with it, also a new crosshead and pin, then the engine was speeded up from 74 to 84 r.p.m., and while some one was sleeping the flywheel inspector came along and condemned the wheel. So a new wheel was bought, and while they were dismantling the wheel a piece weighing 600 or 800 lb. fell out of one spoke and almost killed the foreman and one of the men. The new wheel was put on and the engine still runs at 84 r.p.m., 135 lb. steam, with a cylinder 28 by 48 in., instead of the 24 by 48-in. and 10 r.p.m. faster than the old one and still has the old girder frame, which now is 35 yr. old, and the guide is bolted to it, so that you have nothing but 4 bolts to hold the cylinder to the main bearing. After everything was done, the firm bought 2 more boilers of the same size and make as the 6 new ones, then they had steam enough to operate.


DIAMETER OF CYLINDER 28"
LENGTH OF STROKE 48"
PRESSURE OF STEAM IN LBS. IN BOILER 135
POSITION OF THR. VALVE: WIDE OPEN
ENGINEER'S REMARKS: "I THINK THE VALVE ADJUSTMENT IS GOOD."
H
C

CARD FROM REBUILT ENGINE

This position pays $150 a month for a chief and the firm has difficulty to find a man to take the position.

The enclosed card was taken by the present chief and he thinks there is no danger of the engine going to pieces. The one important thing I have forgotten is this, they have 2 screw jacks under the bottom guide to hold it from breaking off.

Some one that has a little time can take the figures of the new cylinder and speed and see what per cent overload the old original engine and the old girder frame is now carrying. The repairs on this old girder frame cost as much as a new engine is worth, besides the time lost. The company has a letter from the builder saying they would not be afraid to run this engine in their shop at 87 r.p.m. I do not wish to expose the name of the makers of this engine, though it is claimed by some that they make good engines, which may be true, but I think they use very poor judgment in regard to speeds on rebuilt engines of old days.

A SIMPLE way to test the quality of new leather belting to ascertain whether it is made of good or poor leather, is to take a small strip and place it in a strong solution of vinegar. If it be made of a good quality of leather, it will not change, except to turn a darker color. On the other hand, if it be of small strength and generally poor quality, the fibres will quickly swell and the leather will soon turn to a soft, sticky, gelatinous mass. A belt of this kind will give only short service and very seldom pays for its use.—Refrigerating World.

Winter Overhauling Saves Summer Shutdowns

DETAIL SUGGESTIONS FOR PUTTING THE ICE PLANT IN PERFECT CONDITION DURING THE DULL SEASON. BY A. G. SOLOMON

COMPRESSORS of the horizontal double-acting type must be handled somewhat differently from the upright during the overhauling. As a rule, the plant's refrigerating equipment consists of only one compressor and, to do any work, the machine must be entirely shut down. The one place where time can be saved is in the inspection and grinding of the valves. For this purpose, there must be at least one extra suction and one extra discharge valve on hand. See that these extra valves are in first class condition and then pump out and stop the compressor. Put in the 2 good valves and overhaul and grind in the 2 taken out. In this way, the compressor need be shut down only about an hour each time the valves are being changed.

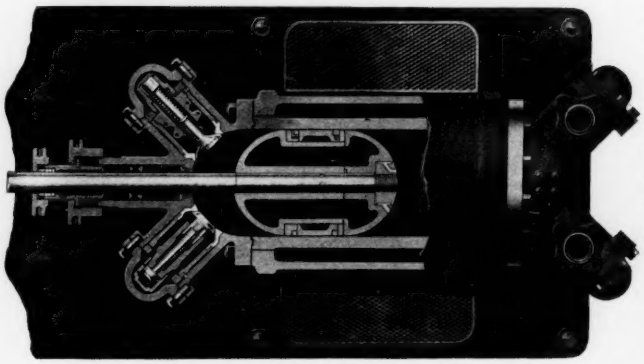


FIG. 1. HORIZONTAL SECTION OF VILTER HORIZONTAL COMPRESSOR CYLINDER AND PISTON

The assembling of all compressor valves must be done carefully to be sure that all parts fit properly and that nothing can come loose. The suction valve in most makes of this style compressor may drop into the cylinder, and when this happens something has to burst, often the compressor head.

The piston is taken out at the first opportunity when the machine can be spared for at least 12 hr. If it is a solid piston with snap rings, it receives the same treatment as the one in the upright machine; but if it is of the built-up type, more attention is required. To take such a piston apart, the nut at the end of the rod must be loosened before the rod is loosened at the crosshead. The screwed dowel (half in end of rod and half in piston) is first removed and the nut then loosened either with a spanner wrench or with a properly bent bar and sledge hammer. The rings are found to be set in between the 2 halves of the piston and are held out against the cylinder walls by means of a number of springs. The tension is sometimes adjusted by setting out screws which are kept in place with lock nuts. When this style of piston is being assembled, the central position must be maintained by using calipers and adjusting the bull ring. After the rings have been examined and the proper tension set, the piston is again put together. The nut must be set up as tight as possible and often the hole formerly used for the dowel will not come in line. If such is the case, drill and tap a new hole and fill the old one with babbit. Do not back off the nut even the slightest fraction to make the old dowel hole come in line. It will result in a loose, noisy and leaky piston.

The horizontal cylinder must be calipered for roundness, as it often wears. If found at all out of round or with a shoulder, or if score marks are present, the cylinder must be bored.

The packing of the ammonia rod is a particular job. If the rod has been turned down, owing to cuts or a shoulder, the back end of the stuffing-box must be fitted with a babbit ring or an iron ring lined with babbit. The oil lantern and gland must also be babbited and bored out to just a nice sliding fit on the rod. Failure to do this will result in packing trouble, as the packing will be cut up and drawn into the space between the rod and the ring and oil lantern.

Be sure to get the oil lantern in a central position with regard to the oil and gas relief lines. The valve in the gas relief line must be examined as it often blocks up with pieces of packing. The rod and packing will give trouble if this line is not clear. And while speaking of the stuffing-box, the question of rod lubrication must be

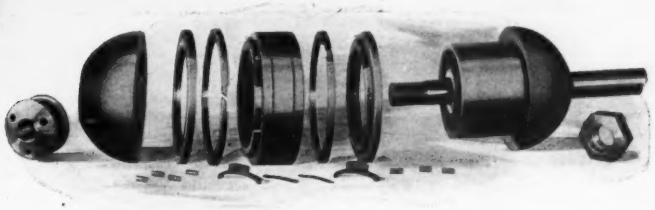


FIG. 2. THE VILTER PISTON DISASSEMBLED

dealt with. Owing to the depth of the stuffing-box and the tightness of the packing to hold the condenser pressure, the rod and packing must be supplied with a liberal amount of oil. But careless use of the oil will result in the introduction of oil into the entire system, where it has a bad effect, as it acts as an insulation both in the evaporating coils and the condenser. It also helps toward the decomposition of the ammonia. A good lubricator, set to feed slowly and regularly, should be used for feeding the oil into the bottom opening of the stuffing-box.

Too much oil put into the lantern will allow of its being drawn into the machine through the gas relief line. Never use an oil pump or lubricator to put oil directly into the cylinder, as it is not needed. There is enough oil circulating with the ammonia to do the necessary lubricating of the valves and cylinder. In fact, there is seldom a refrigerating system which has been in operation 6 months which has not too much oil in it.

Setting the clearance in the horizontal compressor is done in the same way as in the vertical, only that both ends have to be watched. The rod should be trammed before the piston is taken out; and when the machine

is put together again, the position must be the same as it was before. Then, with a valve out at each end of the compressor, the machine is turned over by hand and the amount of clearance measured with a piece of lead or fuse wire which is held between the piston and the cylinder head. The greatest clearance should be at the head end, as the rod will lengthen when it becomes warm.

If the clearance is found to be about, or a little less than, 1/32 in. on the crank end and about 3/64 in. on the head end, it is as good as can be expected. If a greater amount is found, a thinner gasket may be used on the head and the rod adjusted to get what is wanted at both ends. If not enough clearance is found, use a thicker gasket. Always remember that a rubber gasket has but little compression, when cut a snug fit in the female recess found on the end of the cylinder. A 1/16-in. rubber gasket will give 1/16 in. more clearance and will not squeeze down to 1/32 in. The clearance may be changed during the summer's run, owing to keying up of the bearings; but as long as it is known how much clearance space is in the cylinder, the rod can be screwed in or out to keep it even at both ends.

Ammonia Condenser and High Pressure Piping

If the plant can be shut down long enough, it is always best to pump all the ammonia out of the condensers and store it in the evaporating coils while the condenser is being overhauled.

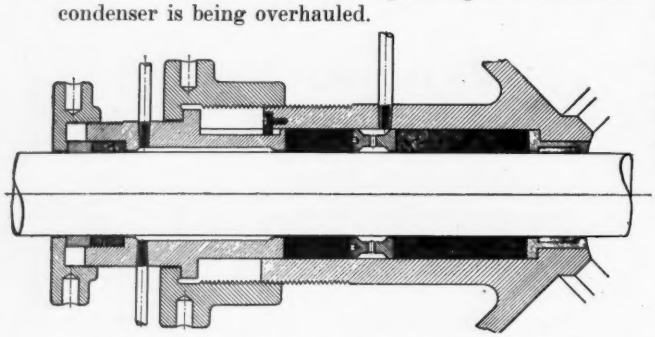


FIG. 3. SECTION OF STUFFING-BOX SHOWING CONSTRUCTION OF LANTERN GLAND AND LOCATION OF AMMONIA AND OIL RELIEF PIPES

If this cannot be done, 1 or 2 stands at a time must be pumped out and the work done in sections. To do this, all leaking valves must first be repaired.

Most ammonia valves are made with a disk which has its seating surface made of soft metal. All that is necessary is to melt out the old metal and pour in a new seat of babbit and face it off in a lathe or with a file and face plate. All valves on the condenser and all other ammonia valves should be packed with a good grade of soft, well-lubricated packing, and they should also be protected from anything that will cause rust either by some suitable covering, made of galvanized iron, or else the stems and packing nut should be wrapped with strips of cloth which have been soaked in a mixture of half tallow and half white lead.

All ammonia valves must be kept in such condition that they can be closed quickly and tight without the use of a wrench.

Defects to look for in the condenser and other ammonia piping are: bolts that are rusted and on which are nuts that will not turn; pitted pipe; pipe eaten thin close to the flanges and where the brackets come in contact; scale on the outside and oil on the inside; cracked flanges and fittings; uneven water distribution; packing of glands on double-pipe condensers; poor hangers and brackets. Just a little thought and study will show the way to overcome all the troubles met with. Condensers and all the piping and receivers subjected to the condenser pressure must be tested with an air pressure of 300 lb. Anything that will not stand this test has no place in the high-pressure side of the system.

The glass gage on the liquid ammonia receiver should receive a little attention. Examine the packing of the stems of the cocks and make sure that these may be closed quickly in case the glass should break.

The Evaporating Coils

As a rule, the evaporating coils, whether they be direct expansion or submerged in a brine tank must be cleaned of the oil accumulation every few years, depending on the amount of oil allowed to enter the system. The coils are first pumped out and disconnected at both inlet and outlet ends. Then each coil is blown out with steam, which is followed immediately with air to remove the moisture. After all the coils are blown out and again connected, they must be tested with from 100 to 150 lb. air pressure and made tight before any ammonia is turned into them.

After the plant has been overhauled and started in operation again, the system will most likely contain some air, as it is nearly impossible to expel all of it at the time the work is going on. Before the warm weather begins, there is plenty of time to purge the condensers several times. Go at it easy and blow out as much as possible at a time without losing any ammonia.

Trouble With Ammonia Compressor

By J. C. Hawkins

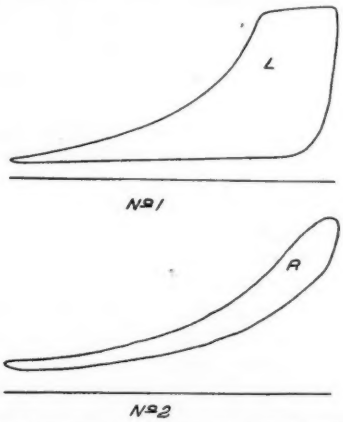
SEVERAL years ago, the engineer of an ice plant in the vicinity of the plant in which I was employed, had trouble with his 15-ton ice plant. The machine was a York compressor, 2 single-acting cylinders driven by a Corliss engine. The weather was getting warm, and the machine would not produce the required amount of refrigeration which it had done other years. The trouble was thought to be in the compressor, because one cylinder ran warmer than the other, although the same quantity of cooling water was used on each.

Having just purchased a new indicator, I got off a half day, and went over to help the engineer out. The indicator was first connected to the steam cylinder, and a fairly good diagram taken; no trouble there. Next, the indicator was connected to the left-hand compressor cylinder, and diagram No. 1 taken; this looked fairly good to us, so the indicator was applied to the right-hand cylinder, and No. 2 taken.

This showed at once that there was something wrong in this cylinder, and that it was not doing as much work as it should. The high re-expansion pressure in the cylinder on the suction stroke shows that considerable gas was leaking back into the cylinder through the discharge valves, which prevented the gas from the suc-

tion pipe from being drawn in. The machine could not be spared very long at a time, and after studying the situation, we decided to examine the springs and discharge valves on the defective side. The necessary tools were gotten ready, and the machine stopped. After getting the cylinder open, we found one valve spring broken, and all the discharge valves were badly gummed up with a putty-like substance of grease and scale. The valves and springs were washed with coal oil, and a new spring put in place of the broken one. After the machine was started, the indicator was applied again and a diagram similar to No. 1 taken.

From the conditions found in this cylinder it was decided to open the other compressor at the first opportunity, for the purpose of examination, and cleaning out the valves. After overhauling the machine the output of ice was increased to its regular amount.



CARDS FROM AN AMMONIA COMPRESSOR

If the machine is to do good work, the discharge valves must be examined occasionally, as a slight leakage back through the valves will greatly decrease the output of the compressor. The spongy substance in the cylinders was thought to have been due to the use of a poor grade of ammonia oil in the compressor, which was being used at that time on account of its low price. Changing to another grade of oil helped to prevent further trouble from valves sticking.

Oil and Driving Belts

Wiper Arrangement to Prevent Oil Travel Along Hub and Shaft. By Karl Hoffman

IN a small motor-driven ammonia compression plant, with which I am familiar, considerable trouble was experienced through oil getting onto the running surfaces of the belts driving the compressors. For this reason, it was rather difficult to operate one of the compressors at all.

When looking for the cause, I found that the inside face of the flywheel hub ran close to the outer bearing, and owing to the spaces in the hub, the oil followed the crank shaft through these spaces, and ran down the arms onto the inside surface of the flywheel, eventually getting onto the driving belts. When a compressor was stopped, matters were even worse, for the oil continued to drip for some little time.

The method of securing the flywheel to the crank shaft is shown in Fig. 1.

As a remedy, the spaces were filled with babbit, as shown at B, close up to the edge of the face of the hub running next to the bearing, and at a distance of about 3 in. back the length of the spaces.

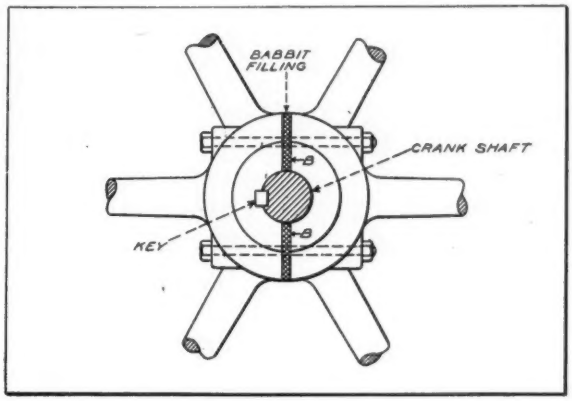


FIG. 1. SHAFT AND FLYWHEEL HUB

When this was well hammered into place and smoothed off a brass band of about No. 22 gage was attached to the circumference of the hub with a piece of lamp wicking, well soaked in shellac, between.

The way the brass band is applied is shown in Fig. 2. The width of the bearing at this point is considerably less than the diameter of the hub, and in order to catch all of the oil this brass band is extended over the edge of the hub so that the babbited end of the box projects into it.

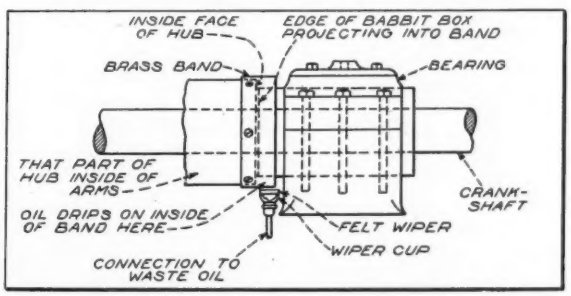


FIG. 2. BRASS COLLAR AND WIPER ON HUB

The running surfaces of the belts were then cleaned with gasoline, after which several applications of whiting were used, which was scraped off until all traces of oil had disappeared. The wiper arrangement is shown in Fig. 2. Any oil that drops on the inside surface of the band is wiped off by the piece of felt as it flows over the edge. The arrangement, as simple as it is, has not only overcome the inconvenience, but has also effected some little saving in waste and oil.

An easily remembered rule for finding the diameter of plunger necessary to pump a given quantity of water at 100 ft. piston speed per minute is, divide the number of gallons by 4 then extract the square root and the result will be the diameter in inches of the plunger.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Locating Leaky Water Tubes

In a recent issue, a correspondent was advised that a leaky tube in a water-tube boiler could be located by lowering a candle, on a piece of wire, between the rows, and noting the source of moisture. I have tried this myself and cannot recommend it. The view between the rows of tubes in the Heine boiler is obstructed, from the bottom, by the lower row, which is set at a different pitch from the others, and many rows are invisible for other reasons. Candlelight is uncertain, as I found out for myself after cutting out a perfectly good tube—the wrong one.

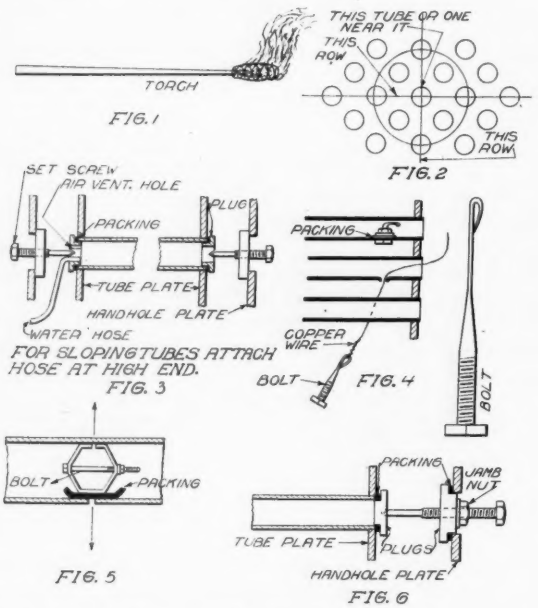


FIG. 1. TORCH USED IN EXAMINING BOILER TUBES
FIG. 2. LOCATION OF LEAK
FIG. 3. TESTING A TUBE FOR LEAK
FIG. 4. PLUGGING HOLE NEAR END OF TUBE
FIG. 5. TOGGLE STOPPER
FIG. 6. METHOD OF PLUGGING TUBE

Figure 1 shows a better light, this is a hard packed bunch of waste, tied tightly to the end of a ¼-in. rod and dipped in gasoline. It will give about 10 candle-power for 5 min.

To locate the leaky tube, slowly fill the boiler with cold water,—this cools it so it can be worked upon comfortably,—until a watchman, stationed in the flame chamber, signals that the leak has begun. Shut the water off at once, and find the height to which the water has risen in the boiler. To do this, remove a handhole in the top row, and sound. The height of the water level tells us pretty well which horizontal row contains the bad tube; but to make sure, let water out of the boiler until the leak stops, and sound again. The man underneath can tell from the point where the water drips into the chamber, which perpendicular row is the offender, so by bisecting these 2 lines we get the bad tube localized into a zone of not more than 6 or 8 tubes. See Fig. 2.

These we can test separately in a few minutes, with the rig shown in Fig. 3, a water hose connection from some local spigot giving a few pounds of service pressure. The plugs can be shifted quickly from one tube to another until the watchman underneath shouts "Tag." Now to lay a boiler up for some hours while a tube is being changed may mean a tieup of the plant; let us avoid it by plugging up the leak. A small hole near the end of the tube may be fixed as in Fig. 4. A copper wire is first inserted through the tube end and blow-hole; this is pushed in until a man below the tubes can grasp the end and twist it on to the end of the small bolt shown, which has been drawn down to a wire size for ease in entering the hole when the wire is drawn up. If the bolt is too big, the hole can be enlarged with a crooked file tang or other means. This elongated bolt is shown in place in an upper tube, with a hex nut, washer, and ring of asbestos packing. Where the hole is too far from the end of the tube to allow of tightening the nut, I have used a toggle stopper, Fig. 5. This is a hexagonal ring, bent up from ¼ by 1½-in. stock, with a ½-in. bolt running through as shown. When the nut is screwed up with a long socket wrench, the ring expands in the direction of the arrows. It takes some care to get this located accurately over the hole, and a helper is needed to tighten the bolt while the ring is held in position with a pair of tongs.

A tube may be plugged at both ends by the method shown in Fig. 6, but this method subjects the plugged tube to burning and distortion so that removal is impossible except on the top and bottom rows, and is justified only when the boiler is to be retubed soon after.

H. K. Scholefeld.

Boiler Construction

In the Nov. 1 issue, Subscriber asks, "Why is the middle sheet of a boiler laid on top of the end sheets?" Mr. Wallace in his reply gives 2 reasons, the second of which is without doubt correct; namely, that were the middle course laid outside of the end courses, there would be formed a pocket in which scale would lodge, and in the worst possible place for such lodgment. The first reason was, "by lapping the end courses over the middle one, the former have a certain restraining influence over the latter, whereas if the middle section or

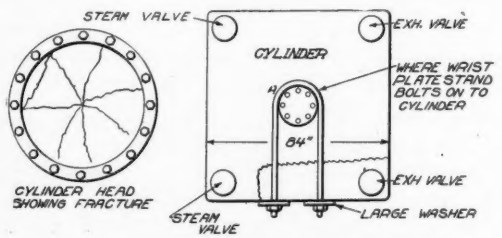
course overlapped the end courses, this restraining influence would not only be lacking, but the rivets would be subjected to a tension stress as well as a shearing stress."

Now, I am unable to see how lapping the courses one way can make the boiler stronger than lapping them the other way. If the outer ring exerts a restraining influence on the inner ring, there would be the same restraint at the joint whether the middle course or the end course was on the outside. As a matter of fact, the outer course, because of its greater diameter, is under a slightly greater stress than the inner course and therefore could not exert a restraining influence, provided, of course, the plates are of equal strength. The only case in which the end course could exert a useful restraining influence would be where the inner sheet was of a weaker material.

To subject the rivets to a tensile stress due to the pressure within the boiler, it would be necessary for the outer ring to stretch, thereby tending to pull away from the inner ring. The rivets are, moreover, put under considerable tensile stress when driven, this in order to make the joint steam-tight. C. O. SANDSTROM.

Repairing a Wrecked Cylinder

AT THE blast furnace here, where there are several large vertical blowing engines, is a very large engine. The piston rod on the stem end (lower end) is fastened into the crosshead by means of a large key. This key worked loose and came out while the engine was running, and as the piston and piston rod weighs several tons, it made a bad wreck out of the cylinder and cylinder head of the engine. The piston struck on its cylinder head and fractured it in much the same manner that a large plate of glass would be fractured by means of a large hammer, as shown in drawing.



CRACKED CYLINDER AND METHOD OF REPAIR

The cylinder was also badly cracked, as shown in drawing. The engine was of the Corliss type and 84 in. in diameter and thus was a large job to repair.

The break in the cylinder was welded by the oxygen-acetylene gas process and it was considered a very good weld; but in heating the cylinder for the weld, the cylinder warped so much out of true that the cylinder main bore and the bore for 2 of the valves had to be rebored and a new piston and 2 new valves had to be made to fit the engine after reboring.

The old piston was also badly smashed when it fell. Several of the stud bolts that held its bottom head in place were in such bad shape by having the cylinder crack to the bolt hole that it was thought best to reinforce them some way. Large bolts were made and hung over the wristplate stand base on 2 sides of the cylinder and to curve down through the head with large nuts and washers on the lower end so as to support its cylinder head.

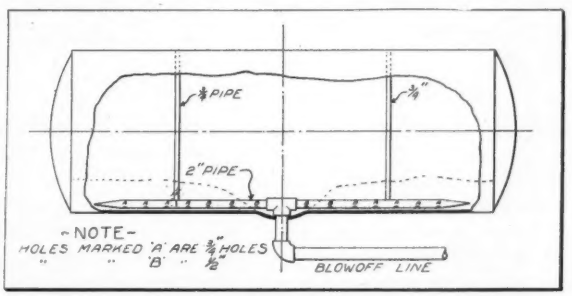
The job all told required quite a bit of time for completion, but when it was completed and engine was started up, the job held pretty well for a patched-up job.

O. L. H.

Internal Blowoff Piping

ACCOMPANYING drawing illustrates a mud extractor for the mud drum of a boiler, which we have working in 8 Stirling boilers.

Take 2 pieces of 2-in. pipe 5 ft. long with threads on one end and the other end flattened out and drill 4 ¾-in. holes 6 in. apart from the end towards the center, and 3 ½-in. holes 6 in. apart from the center towards the threaded end. On the other side of these pipes, but in their centers, tap out ¾-in. pipe threads. Place a 2-in. nipple 6 in. long in a 2-in. tee and place the 2 5-ft. pieces of pipe on the tee and place the pipe in position in the bottom of the drum with the 6-in. nipple extending down the blowoff hole, and so arranged that



INTERNAL BLOWOFF PIPING FOR STIRLING BOILER

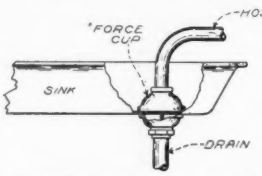
the ½-in. and ¾-in. holes in the pipes point to the bottom of the drum. Take 2 pieces of ¾-in. pipe 40 in. long and put 2 in. of thread on one end; screw these into the ¾-in. holes that have been tapped in the 2-in. pipe far enough so that their top ends will pass under the tubes in the top of the drum and then back them out until they go firmly against the top of the drum. This arrangement will hold the pipe firmly in place on the bottom of the drum. Now, when the boiler is blown down, the mud will be sucked up from the bottom of the drum through these perforations in the longitudinal 2-in. pipe, while without this arrangement the mud for a distance of only about 12 in. around the blowoff hole is carried out, as illustrated by the dotted lines. GEO. A. SCOTT.

Some Properties of Rotary Converters

RELATIVE TO the mechanical oscillators mentioned in the above-named article by O. H. Henschel, on page 966 of the Oct. 15 issue, it may be of interest to some of the readers of Practical Engineer to know that when the tempered plate of these oscillators, located at the end of the converter shaft, is worn, it may be replaced by one of soft steel, case-hardened on its face. A plate like this is cheaper and will last longer than the others, as there is no loss due to plates cracking while being tempered. W. E. SMITH.

Cleaning Drain Pipes

In most places where stationary engineers are employed, there is an equipment of sanitary apparatus of which, usually, the engineer has charge; one of the most frequent causes of trouble in this apparatus is choking of the drain pipes. Our method of unstopping these drains may be of value to some engineer or perhaps he can tell us of a better way to overcome the trouble.



METHOD OF ATTACHING HOSE TO FORCE CUP

We take the handle out of an ordinary rubber force cup, such as the plumber uses, insert a section of ¾-in. hose in the socket, attach the other end of the hose to a source of water under pressure, turn the water on and press the pipe of the cup down firmly over the outlet to the sink, or whatever it may be, when the force of the water will generally drive the obstruction out of the pipe. J. O. Benefiel.

Should Pulleys be Covered?

Pulley coverings, such as paint, canvas, leather, etc., should not be used unless absolutely necessary. Coverings cause undue belt wear.

A pulley covering is intended to produce greater efficiency by increasing the frictional quality of the pulley face, the latter being accomplished by roughening that face. Any pulley covering that is in the slightest degree rougher than the polished metal, raises the belt up on the highest points of the rough surface, thereby decreasing the area of contact between belt surface and pulley surface, and thereby increasing the tendency to slip by a corresponding amount. The tendency at peak loads is thus toward decreased instead of increased transmitting capacity.

No material with which it is possible to coat a pulley will absolutely prevent creep. Creep is inevitable, because of the elasticity of all belting materials—even of steel. We thus have a "stretched" belt going onto the driving pulley and a "shorter" belt leaving the pulley.

Creep of this kind often amounts to 2 per cent of the belt travel; that is, the driven pulley moves only 98 per cent as far as it should or would if there was no creep.

It is therefore evident that if a polished metal pulley can be made to pull without slip (note the difference between slip and creep). There will not be so much heat generated because of creep, for there is not so much friction between a smooth metal surface and rough belt as between 2 rough surfaces. Hence, without the pulley covering, there is less danger of injury to the belt. Besides, absolute prevention of slip is not always desirable at all times.

Under starting torque or sudden imposition of heavy load, a slight momentary slipping is essential to permit the belt to assume its load gradually as it should. If the contact is too rough, results are often disastrous.

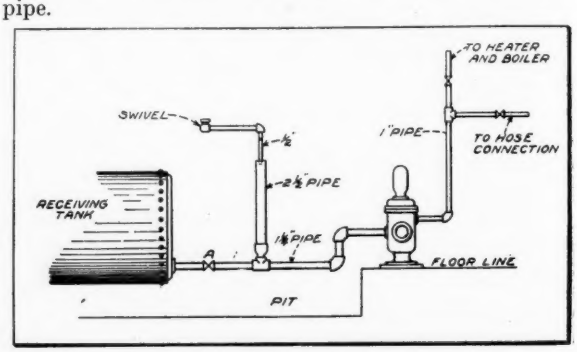
Pulley coverings rarely retain the uniformity of face which they have at the start, and the growing irregularity continues to decrease belt contact and belt efficiency. As the glue or cement with which the covering is held dries out, becomes brittle and cracks, the intimate pulley contact is disturbed and slippage is aggravated. Furthermore, the dependence on pulley coverings alone for increasing belt efficiency does nothing to preserve the belt fabric and keep it in good pliable condition. Efforts to produce perfect belt efficiency through manipulation of the pulley face do not offer the proper solution, and tend to aggravate rather than stop the trouble.

It is my opinion and the opinion of the best belt experts of my acquaintance that slip troubles usually lie in the belt—not the pulleys. N. G. Near.

Pump for General Use

Herewith is shown a diagram of the piping from a receiving tank to a small pump which can be used as an auxiliary boiler feed, a compound feeder, a pump for washing boilers or a small fire pump.

The suction pipe is 1¼-in. and the standpipe of 2½-in pipe about 30 in. high, with the top open. A ½-in. pipe from the city pressure operating on a swivel joint is bent so that the end will drop inside the 2½-in. standpipe.



PUMP PIPING FOR GENERAL USE

When used as a boiler feed, the valve, A, is open and the makeup water is added through the ½-in. pipe. When used as a compound feeder, the valve, A, is closed and the dissolved compound poured into the standpipe after the ½-in. pipe is swung up out of the way. To use it as a boiler washer, the city pressure is run in the 2½-in. pipe and the valve, A, partly closed. The water in the tank being hot, a proper manipulation of this valve will give washing water at any desired temperature. For use in case of fire, the valve, A, is closed and the water from the ½-in. line turned into the standpipe.

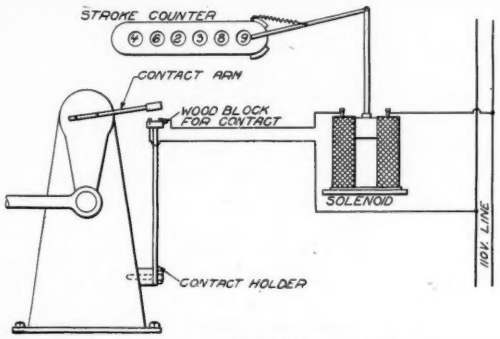
Geo. B. Longstreet.

Governor Gagpot Repair

Relative to the letter of Harry H. Johnson, on page 972 of the Oct. 15 issue, I should consider it better to tap 2 holes in the gagpot and put in a bypass with a valve so as to regulate the flow of oil from the outside. It is quite a job to disconnect the gagpot every time the oil becomes thick, and at times we get oil not fit for the size of holes. Temperature also affects the oil considerably. Chas. Magnus.

An Electrical Stroke Counter

HEREWITH is a sketch of an electrically operated stroke counter, for boiler feed pumps. At the plant where I am employed as assistant engineer, we have 2 plunger type duplex boiler feed pumps. We had one stroke counter mounted on the rocker stand of No. 1 pump. Of course, this pump could not be run all the time and it was desired to keep tab on all the water

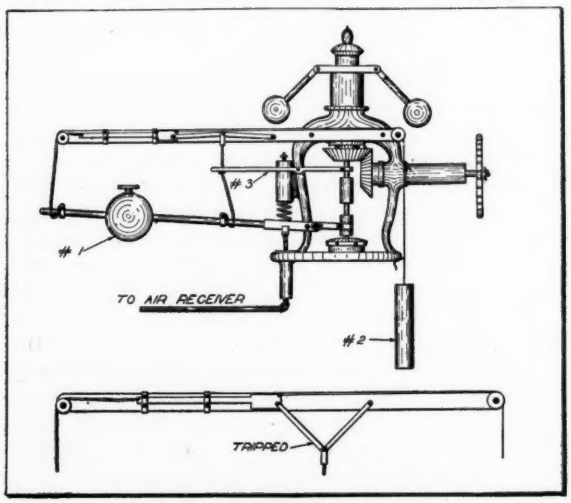


CONNECTIONS TO AN ELECTRICAL STROKE COUNTER

fed to the boilers. I arranged a make and break contact arm and fastened it on the end of the rocker shaft as illustrated, with a cutout switch for each pump. The solenoid can be made to operate on a battery circuit as well as on a 110-v. lamp circuit, and the stroke counter can be placed at any point in the plant, preferably in the chief's office. C. G. NELSON.

Safety Governor for Air Compressors

AN AUTOMATIC stop, designed, and applied by me to an air compressor, works perfectly. Applied to a throttling governor, it works as follows. If an air pipe breaks, or anything causes the pressure to fall suddenly, the weight arm, No. 1, drops, pulling the knuckle down,



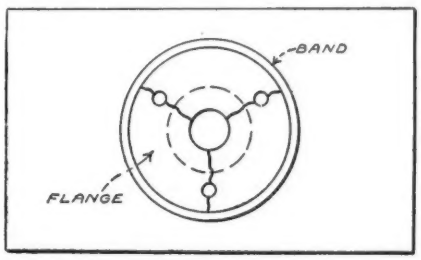
SAFETY GOVERNOR DETAILS

allowing the weight, No. 2, to pull the arm up, closing the throttle, or shutting the steam off. Again, if the governor chain breaks or comes off, the small lever, No. 3, trips the knuckle and shuts the steam off the same way. My compressor ran away twice before I applied this device. W. I. CRAWFORD.

Repairing a Broken Gland

MY TROUBLES began months before the piston gland on a large Corliss engine broke. Changing load and side motion of the piston, with poor packing, seemed to be the main cause of trouble. I surely had to watch those nuts; if I crowded too much, the rod would get hot.

The night the break occurred, I seemed to have unusual trouble. All at once there was a crash and roar. I ran up and shut the engine down. As it was late in the night, the smaller unit carried the load all right. There was my packing blown out, and the gland broken into 3 pieces. I also found that the crosshead shoe on the bottom guide was loose, and played back and forth about 3/8 in., causing an up and down motion of the piston. Next day we took the pieces of



BROKEN GLAND AND REPAIR

the gland over to the blacksmith and had him shrink a band around the 3 broken pieces of the flange. Luck favored us in the break, each piece beveled off at the gland and the cracks followed the bolt holes. It was the turning point for better; I use Skookum and Daniels P. P. P. packing mixed now, which gives very good results. I also cut out some of the compression of the engine, which helped matters a great deal.

On the same engine there was a small break which puzzled me for a while. My exhaust would vary. Working my reach rods would help matters for a little while, when the same trouble would appear. The trouble was, one of my blocks had been broken in two, being loose; but held in there, it caused a varying trip of the valve gear. G. H. BROUGH.

Babbiting Crankpin Boxes

A. L. JOHNSON'S method of babbiting crankpin boxes, described on page 975 of the Oct. 15 issue, is all right as far as it goes; but I have found it necessary to locate the clearance before disconnecting the rod and making allowance for it when rebabbiting.

If the piston rod screws into the crosshead, this can be taken care of in that way; but if the rod is attached to the crosshead by taper fit and key, the clearance must be carefully looked after to obviate the necessity of using shims. This is of especial importance if both the crankpin and the crosshead boxes are to be rebabbited.

I have also found that it pays to take time to stretch the babbit by peening with a hammer after babbiting and then bore the boxes to size. After the right size is obtained, shorten the cutter in the boring box, move the box over from the center, and take a light chip on the top and bottom for clearance on the lips of the box. S. J. SMITH.

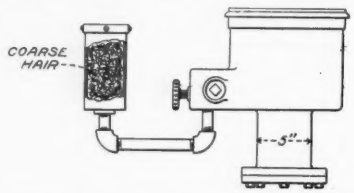
Successful Kinks From The Plant

For Saving Time, Work and Trouble

Silencing Noisy Dashpot

CORLISS ENGINES that are equipped with dashpots that make considerable noise can be silenced in many ways, but the best way I have seen is by connecting a hair-filled sheet-iron cylinder to the dashpot.

For a 5-in. dashpot, a cylinder 4 in. in diameter and 10 in. long will be large enough. On the top end, a cap is made of ¼-in. mesh wire screen. The cap is



HAIR FILLED CYLINDER CONNECTED TO DASHPOT

held in place by 4 screws. The lower end is connected to the dashpot with 3 nipples and 2 elbows, as shown in the sketch. The cylinder is filled with coarse hair, not packed too hard, so that the air can pass through it. More than one dashpot can be connected to the same cylinder, but its volume should be made in proportion.

L. K.

Repairing Gland on Triplex Pump

IN OUR power plant equipment, we have a small 4 by 6-in. heavy duty triplex pump, which has been in service for 15 yr. The left-hand plunger has become

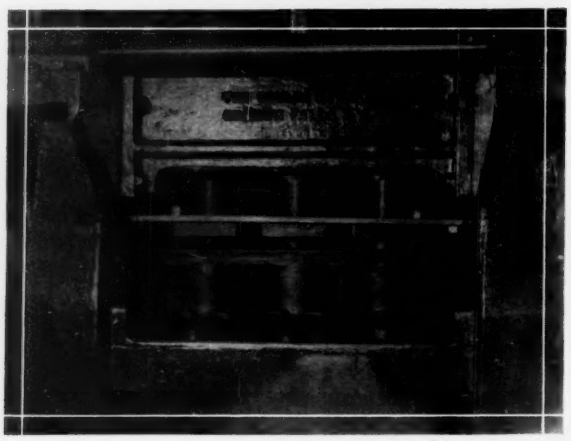


FIG. 1. TRIPLEX PUMP WITH CLAMPS IN PLACE

worn slightly flat on one side, so that it rocks the packing gland in making the stroke. This rocking and the heavy strain on the packing owing to the untrue surface caused several studs to break. The studs were originally ⅝ in. with 4 to a gland. After renewing them, the threads in the base stripped; we then replaced them with ¾-in. studs. After a time, these stripped the threads owing to the corrosion and rottenness of the metal from age. We then had the clamps made and put on as shown by the sketch and photograph.

The clamps were made from ½ by 4-in. boiler plate and cut and drilled to fit over the packing glands and long enough to fit the full width of the pump so that the ends would go under the shoulders of the housing.

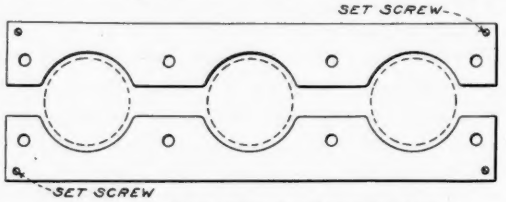


FIG. 2. CLAMPS USED ON PUMP GLANDS

The clamps were drilled to fit over the stud bolts and then a ¾-in. hole was drilled and tapped close to each end in which was put a ¾-in. set screw, so that after the glands were tightened down the set screws were set up against the frame.

With the 2 set screws in the end of the clamps and the aid of the studs of the other glands, the strain was relieved on the one that gave trouble. No studs have been broken since the clamps were put on.

L. M. JOHNSON,

Pump Trouble and Remedy

ON BOARD ship we have a Warren steam pump, 12 by 14 by 12 in., used for flushing purposes. As seen by the measurements, this pump is intended for low pressure duty, having a small steam end and large water end.

A little over a year ago, we started to carry a back pressure of 20 to 30 lb. on our auxiliary exhaust line into which this pump, along with other auxiliary machinery, exhausted. Then this pump would be seen to "hang up" about midway of each stroke, sometimes running all right for a few hours.

On removal of the valve chest and cylinder head, and a complete examination, nothing could be seen to be wrong. After replacing and starting again, it would perhaps run ½ day, then start hanging up again. After watching the action of it I came to the conclusion that the valve was being forced off its seat, and steam was entering both steam ports, this being caused by the back pressure on the exhaust line along with the peculiar construction of the steam chest passage.

Referring to Fig. 1, S_1 and S_2 are steam ports, EX the exhaust port and S a port or opening directly to steam from throttle, but having no connections to cylinder nor exhaust.

Steam from the throttle enters at A and fills steam chest S_3, S_4 and S. Now, this pump's slide valve, Fig. 2, is a common D valve and is intended to be kept on its seat by the steam pressure, which it did very nicely till we increased our back pressure.

Then the back pressure acting against the valve face, along with the live steam at S, would every once in a while throw the valve off its seat.

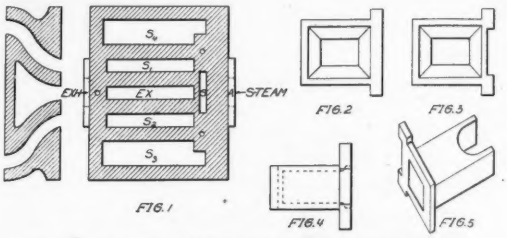


FIG. 1. PORTS TO STEAM CYLINDER OF PUMP
FIG. 2. FACE OF VALVE BEFORE ALTERATION
FIG. 3. FACE OF VALVE AFTER ALTERATION
FIG. 4. SIDE VIEW OF VALVE
FIG. 5. PERSPECTIVE OF VALVE

I removed the valve and cut out that part of its face that covered S, after which it was as in Fig. 3. This allowed all live steam pressure on the back of the valve and nothing but exhaust back pressure on the face. This pump has given no trouble since this alteration.

Figures 3 and 4 are side views of the valve. The round ports above and below S are steam ports to cushion valves and have nothing to do with S.

C. H. WILLEY.

A Trigonometrical Kink

FREQUENTLY, it is required to determine, quickly and accurately, angles in connection with drafting work, and where they are to be interpreted in divisions of

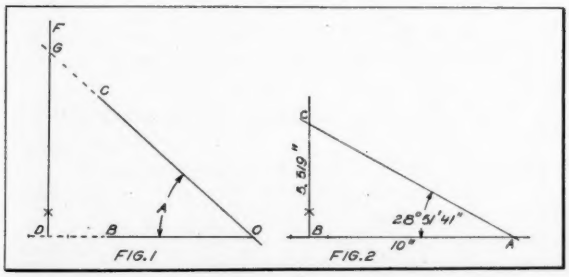


FIG. 1. HAVING GIVEN ANGLE A, TRIANGLE ODG MAY BE CONSTRUCTED SO THAT VALUE OF TANGENT A MAY READILY BE FOUND

FIG. 2. WITH AB EQUAL TO 10 IN. AS A BASE AND BC EQUAL TO 5.519 IN. ERECTED THERETO, WE CAN, BY JOINING AC CONSTRUCT AN ANGLE BAC WHOSE TANGENT IS EQUAL TO 1/10 OF 5.519

degrees, the reading of ordinary protractors, particularly of small range, is difficult, and the following method will be found useful.

Suppose, for example, it is required to determine angle A, in Fig. 1.

Measure off on OB or OB produced, OD equal to 10 in. and from point D erect a perpendicular DF of indefinite length; also extend OC if necessary to intersect DF at G. Now DG measured to the same scale as OD, is numerically equal to 10 times the natural tangent of angle A. If, for instance, DG is measured and found to be 9.28, the tangent of angle A is 9.28 ÷ 10 or 0.928, and from tables of functions of angles, A = 42 deg. 51 min. 41 sec.

Again, suppose it is required to lay off an angle whose log tangent is 9.74187. As this is the log of the natural tangent, it is only necessary to find from a table of logs, the natural number, which is 0.5519, which number multiplied by 10 gives the altitude of a right triangle whose base is 10 in. long, as in Fig. 2.

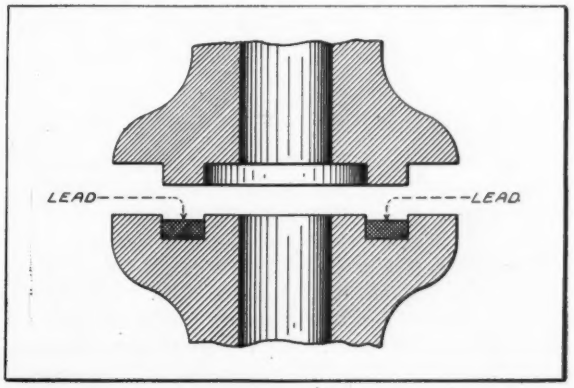
Any length of base can, of course, be chosen, although 10 in. is manifestly most convenient.

H. B. WRIGLEY.

Making a Tight Ammonia Joint

NOT LONG AGO, I was almost "up against it" in tightening an ammonia joint of the type illustrated in the sketch herewith—a lead gasket resting in the female groove of the joint against which the tongue is pressed by means of 2 bolts, not shown in the sketch. You all know the type.

I used my utmost strength on the bolts, tried about a half dozen different gaskets, filed, scraped, and did almost everything known in the pipe fitting line to make the joint tight, but without avail. My soap solution still bubbled. I was doing the work under air pressure.



AMMONIA JOINT TIGHTENED BY MELTING THE LEAD IN THE GROOVE

Finally, noting that the pipe was vertical and that the groove was directed upward, I could see no good reason why I shouldn't attempt to melt the lead right in the groove and see if I couldn't make a good molten fit. I tried it and it worked the first time. I first bolted the flanges together under slight pressure and then held them in position with metal strips so that when the lead had melted the upper flange would not drop down and force out the lead. Then I melted the lead by heating the entire joint good and hot and then I simply allowed it to cool off as slowly as it wanted to. After solidifying, I tightened the bolts fairly solid, turned on the air, and lo and behold! the joint leaked no more.—Refrigerating World.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Furnace Problems

WHAT IS the object of mechanical draft other than that of increasing and controlling the rate of combustion?

2. What is the object of heating air before admission to the furnaces besides that of increasing the temperature of the furnace, thereby making use of the heat of the waste gases?

3. State the advantages of induced and forced draft and of each over the other.

4. What is smoke and what causes it?

5. How may it be prevented in marine work?

6. Is its prevention conducive to economy, and to what extent?

7. What is the effect of unnecessary draft pressure?

8. What is the effect of too low a draft pressure?

9. How does height of smokestack affect it?

10. What is the most desirable stack temperature, not in degrees of heat?

11. How are boiler efficiencies affected by air leaks?

ANSWERS

ASIDE FROM increasing the rate of combustion and accurate control of this rate, there is no special advantage in mechanical draft. The advocates of this system emphasize the fact that the cost of a tall chimney is avoided; but against this there is the expense of operation of the draft system, which, as a rule, is as great as the interest and depreciation charge on the chimney.

2. Heating the air before admitting it to a boiler furnace gives a more even temperature in the furnace and, therefore, avoids local expansion and contraction which might be produced by streams of cold air coming through holes in the fire against the boiler shell. It also tends to keep a higher temperature in the furnace and combustion chamber, which is conducive to good efficiency.

3. The advantages of induced draft are that it avoids a pressure in the ash pit, fire room and furnace. For marine work, this gets rid, of course, of the closed stoke rooms, and this does away with the blow-back which may occur if draft is not shut off before the firing doors are opened. The action is more like that of a chimney than in the case of forced draft, and a more flexible control of the draft is obtained. Any leaks in the boiler setting will be inward rather than outward, so that gases will not be forced into the boiler room. The draft apparatus is placed above the boiler or in the stack, and thus space is saved in the boiler room. It is claimed, also, that this system gives a more even flow through the tubes than is the case with the forced draft.

On the other hand, the induced draft fan must handle a much larger volume of gases than the forced draft, because it has to handle the gases from the coal as well as the air, and has to handle these at a high temperature. This makes it hard on the fan and difficult to keep the bearings lubricated, but spite of this, many such installations are running satisfactorily.

Advantages of the forced system are, that it handles a small volume of cool air, therefore is easy to take care of. The fan is accessible for inspection and repairs, and is more convenient to get at for control of speed.

4. What is ordinarily termed "smoke" is the gases from a boiler in which there is a large amount of free carbon in fine particles. This is not really a very large percentage of the total fuel, but indicates a condition of poor combustion, and is usually accompanied with large amounts of unburned gases, which are the real source of loss.

5. The prevention of smoke is the same in marine work as anywhere else. It means so handling the boiler as to get complete burning of the fuel. This means the air supply properly adjusted, and a high temperature maintained in the furnace and combustion chamber, and sufficient space in the combustion chamber to permit of full burning of the gases before they are cooled by contact with the heating surfaces of the boiler.

6. This is practically answered in Question 4. There is one caution, however—admission of too much air may prevent smoke, yet reduce the efficiency of the boiler. As a rule, it is found that the best conditions for economy are secured when a light haze of light brown smoke is maintained at the top of the stack.

7. Unnecessary draft tends to pull holes in the fire bed, to supply more air than is necessary, and to carry a large amount of waste heat up the stack.

8. Too little draft usually results in insufficient air supply, and thus prevents the burning of enough coal to let the boiler give out its full capacity.

9. The higher a smokestack, the greater the draft which it can produce.

10. We do not understand this question, as the stack temperature is always measured in degrees of heat.

11. Air leaks in a boiler setting will always lower the efficiency. The air comes in at points where it is not well mixed with the gases to produce combustion, usually gives an excess of air and reduces the temperature in the combustion chamber so that it slows down combustion and thus lowers efficiency. A. L. R.

Steam Expansion

WHAT IS meant by expanding steam or working steam expansively?

A. In the early types of steam engines, the valve had no lap and steam was carried throughout the stroke at initial pressure, identically the same as is done in

the common duplex pump. Speed was controlled by a throttling governor of crude design. Later on, it was found by experimenting that by adding a certain amount of lap to the valve, the steam could be cut off constantly at a predetermined point, usually at about ¾ stroke, and allowed to expand during the remainder of the stroke. Still, the throttling governor was used in a more refined state, to maintain a constant speed.

Then Geo. H. Corliss conceived the idea of admitting steam to the cylinder at boiler pressure for a greater or less portion of the stroke, depending on the load, and at a point under control of the governor the action of the valve would be retarded by a tripping device, when a spring or vacuum dashpot closed the valve promptly, thus allowing the steam in the cylinder to expand during the remainder of the stroke after the valve was closed. GEO. H. WALLACE.

Mass. Examination Questions on Steam Turbines*

WHAT CAN BE SAID about clearance in a Curtis turbine?

A. As the pressure is uniform at all points, there is no tendency for steam to pass elsewhere than where directed by the nozzles, therefore you don't need a close clearance; in practice, 1 to 2 in. The reaction type, to secure high economy, must have a minimum clearance at this point.

42. Do you need a balance piston on a Curtis turbine?

A. As the pressure on both sides of bucket wheels is equal, the wheel is in perfect equilibrium. In a reaction type, there must be large revolving rings called "dummies" or "balance" piston to take up end thrust.

43. How is the increased volume of steam provided for?

A. By increasing the height of the buckets and by increasing the number and area of nozzles from stage to stage.

44. How long are the buckets usually made?

A. First stage or high-pressure buckets, less than 1 in.; low-pressure stages may be 8 to 10 in. long.

45. What provisions are made for the decreased volume in a Curtis?

A. The lengthening of buckets from one stage to another.

46. Are the buckets the same length in a given stage (Curtis)?

A. No, the buckets are a little longer at the end of the stage. This is not for expansion, but for the decreased velocity; longer buckets are needed when the velocity is less.

47. Describe the construction of a Curtis wheel.

A. It is a steel disk with buckets on the edge dovetailed in. After holes are plugged, a shroud ring is riveted over them.

48. What is a shroud ring for?

A. It stiffens the row and reduces vibration, and assists in retaining the steam flow in the bucket space.

49. How is thrust taken care of in a Curtis?

A. In the horizontal, there is hardly any; but what there is is taken care of by a roller bearing. In the vertical type, a step bearing is used.

50. What is the emergency stop on a Curtis?

A. It consists of a ring unevenly weighted, attached and revolving with the shaft; when running at normal speed and less the unbalanced ring is held concentric with the shaft, but with excess speed the centrifugal strain overcomes the spring and the ring then revolves eccentrically, and trips the valve mechanism, causing the main throttle valve to close instantly, closing the valve.

51. What is the disadvantage of small clearance?

A. Vibration and distortion by heat may cause stripping of buckets.

52. How is nearly complete expansion of steam taken care of?

A. The width of steam belt is small at the start and increases until all around the periphery.

53. What is a low-pressure turbine?

A. One that takes exhaust steam from engines and expands it to nearly nothing.

54. Are they made same as high-pressure?

A. Yes, on the same plan.

55. What is the advantage of a low-pressure turbine?

A. It allows the steam to expand to a lower pressure.

(To be continued.) W. N. L.

*Continued from page 1023 Nov. 1 issue.

Boiler and Engine Questions

HOW IS overspeeding prevented on a Rice & Sargent Corliss engine?

2. How long are the mud drum nipples on a B. & W. boiler?

3. If, on a vertical boiler, no stays were provided in the water leg, which sheet would give way first? Why? READER.

ANSWERS

A SAFETY STOP and speed limit is usually supplied as a built-in part of the engine. The stop motion is operated by an inertia weight carried by the engine crosshead. Normally this weight is held back against a stop by an adjustable spring, and remains quiet in relation to the crosshead; but when the engine exceeds a predetermined speed, the inertia of the weight at the end of the stroke overcomes the tension of the spring so that the weight moves forward about ⅜ in. and strikes a hammer blow against a lever pivoted to the bed plate. This releases a latch and allows the valve gear to be moved up by a spring to the zero cutoff position, corresponding to the highest point of travel of the governor.

2. To our knowledge, no definite length of nipples is employed. This is a matter governed by the size of the boiler.

3. The inner sheet would be the first to give way, due to the fact that any cylindrical surface when subjected to an outside force will collapse. The amount of resistance this same sheet may offer to an internal force acting outward is limited only by the strength of the material and efficiency of the joints. O. H. H.

NO MATTER how well a man has trained himself, there is still something to be learned, and he must make the training a continual process if he would keep up with the procession.—Canadian Manufacturer.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

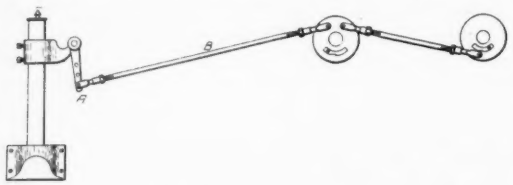
Load Distribution in Compound Engine

ON PAGE 1020, of the Nov. 1 issue, T. N. asks how to distribute the load between the 2 cylinders of a compound engine so as to get the most economy under a variable load and a fixed cutoff. This I take to mean that the low-pressure side is under the control of the governor, but has no means provided to change the angle of the governor rod arm, as at A in the accompanying figure.

Rod B may be lengthened or shortened, which will act on the cutoff of the low-pressure side, raising or lowering the receiver pressure and cause the high-pressure side to take more or less steam as the case may be, until the load on the high-pressure side equals that on the low-pressure side. The equalization and economy of this method can be found by applying the indicator and figuring the diagrams.

Where the fluctuations of the load are frequent, this method is hardly practicable.

At the plant where I am employed, we generally assume that our engine has more or less lost motion and that the high-pressure side measures the amount of steam to carry the load at rated speed; so we manipulate the cutoff on the low-pressure side until the engine



SERIES OF HOLES IN GOVERNOR ROD ARM ALLOWS VARIATION OF EVENTS IN CYLINDER

makes the least noise and the governor is traveling in its highest position for the load being carried. Often we have to sacrifice a little on the height of the governor for the sake of quietness, which we never hesitate to do. If, however, T. N.'s low-pressure side is not of the releasing gear type, I do not know how it could be changed.

I have seen a cross-compound with a Harris Corliss high-pressure side and an old style Fitchburg admission valve on the low-pressure side. This engine carried 5 in. of vacuum in the receiver most of the time and the engineer wrote to the makers of the low-pressure to see what could be done about it. They, however, could not suggest a remedy.

The engineer then left the plant and his successor carried a receiver pressure of 5 lb. above atmosphere and claimed he was saving the company 300 to 400 lb. of coal a day. He got away with it until it was found he had set the pointer of the receiver gage ahead of its true position.

Some call a valve on a locomotive steam chest, which prevents a vacuum forming in the chest and cylinder while running with the throttle closed, a snifter valve.

JOHN H. ARMSTRONG.

FROM THE question asked by T. N., on page 1020 of the Nov. 1 issue, I presume his engine undergoes a considerable variation in load. As a start it might be well for him to carry a high boiler pressure under the heavier loads, lowering it under the lighter loads. This procedure will cause the high-pressure cutoff to vary, of course, and the conditions which will cause the high-pressure cutoff to be the shortest for a given load and exhaust down to 3 or 4 lb. above the atmosphere will usually give good results because the high-pressure cylinder controls the steam used by the engine under all conditions of ordinary operation.

Some engines are provided with an automatic cutoff on the high-pressure side only, leaving the low-pressure side to be set by hand. In such a case, change the low-pressure cutoff until the value of the receiver pressure is found that will cause the governor to travel in the highest position for a given load, when the engine will be running to the best advantage. Of course, such a procedure is necessary for each change of load of any consequence.

After a while, one knows about what load variations to look for and how long they last. Then, if the cutoff on the low-pressure side is controlled solely by the position of the steam eccentric, the receiver pressure may be changed by relocating the eccentric to give an earlier cutoff for the heavier loads and a lower receiver pressure for the lighter loads causing the low-pressure side to carry the greater part of the load when the engine was heavily loaded and less than the high-pressure side when underloaded.

This method gives good results in many instances. Generally speaking, the receiver pressure brought about by changing the low-pressure cutoff, that will be 2 or 3 lb. lower than the back pressure in the high-pressure cylinder, will give the best all-around results.

2. The only way to find the best receiver pressure to carry is to try out the methods named above and observe the results.

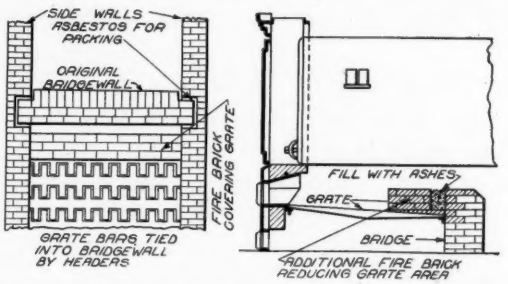
3. Often a small valve arranged to admit atmospheric pressure to any chamber under vacuum, and thereby equalizing pressures inside and out, is called a snifter valve.

RECEIVER.

A Big Grate at Light Load

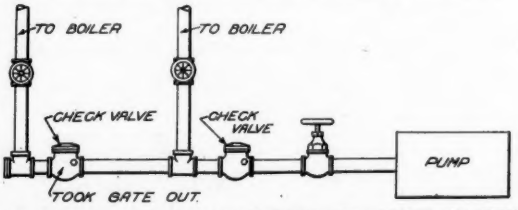
In reply to G. M. C. on p. 976 of the Oct. 15 issue, I believe if he will brick over the rear half of his grate and thus cut down the grate area, causing a brisk fire to burn at all times better results in coal consumption will be realized.

After a fair trial he may be able to cover over more than half the grate. When the results have demonstrated the correct area to be covered it would be well to have the wall facing the boiler front of fire brick, tying it into the side walls, as in the sketch. The space between the new and original bridge wall may be left empty and soot allowed to accumulate, or it may be filled in with earth, perhaps topped with a layer of red brick to facilitate cleaning. Receiver.



SHOWING METHOD OF TYING FRONT AND SIDE BOILER WALLS

In reply to G. M. C.'s question in the Oct. 15 issue, I was up against a similar proposition a few years ago. I covered the back section of the grates with ashes and kept a live fire only on as much of the front section as was required. G. M. C could also bank his ashes under the unused section of the grate, exercising a little care not to let them bank up under the used portion; cleaning grates and ash pits before full load is required.



ARRANGEMENT OF BLOWOFF PIPING BY MEANS OF WHICH ONE BOILER WAS FED BY THE OTHER

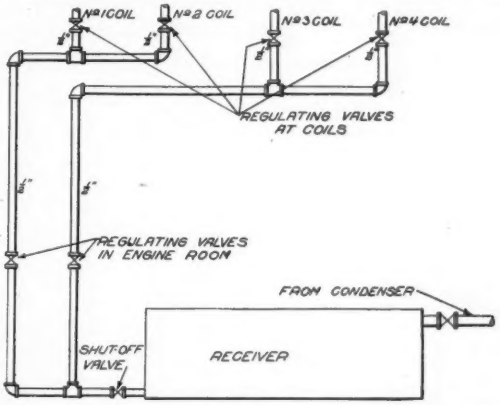
This brings to mind another experience. Picture 2 100-hp. boilers running 24 hr. a day, 6 days a week. Only source of water is the supply tank on the roof; indicator stuck; tank empty; water out of sight in glasses on both boilers, fires pulled and 15 lb. pressure on the gages. How are you going to get water in one of those boilers so as to steam up and get your pump going?

This is the way I did. I shut the valve on the feed line from the pump, closed the valve on the steam main of one boiler and the valves between the boilers and the check valves, took the gate out of one check valve and screwed the cap back in place, tied down the pop valve and let all the steam out of one boiler. I then opened the valves between the boilers and the check valves and the pressure on the one boiler backed the water into the boiler with no pressure. We fed through the blow-off. O. E. T.

Proper Location of Expansion Valves

In reply to the inquiry of J. W., appearing on p. 978 of the Oct. 15 issue, I would advise placing the expansion valves in the engine room near the gages and machine. During the time you go to regulate the valves when they are placed at a distance of 360 ft., a fuse may blow and stop the machine, causing you considerable annoyance.

The accompanying sketch will show a system of piping in my plant in which a 7-ton motor driven machine is at times called upon to carry a 12-ton load. I regulate entirely from the engine room, the valves at the coils being permanently set at the beginning of every season. In this way I find it unnecessary to touch the coil valves during the entire summer.



SYSTEM OF PIPING WITH PROPER LOCATION OF EXPANSION VALVES

I prefer using 2 ½-in. pipes to the coils and single 1¼-in. returns. J. S. Bell.

Distilled Water on Shipboard

Answering J. C. L., page 976, Oct. 15 issue, not considering that used for drinking purposes, passenger steamers carry a considerable quantity of water. That used for cooking, as also the greater part of the boiler feed, is distilled, a small amount of salt water being fed the boilers to form a thin coating of scale so as to prevent pitting. Some of the large ships of our navy have as many as 8 to 10 evaporators.

While it takes a large quantity of steam to produce all of the water required, the ultimate gain is brought about by the prevention of scale and leaky tubes and seams.

The latest evaporators are made with 2 sets of copper coils swinging on steam tight joints. Chas. Magnus.

"We have just had one man badly hurt while engaged in a 'kidding' match. Wrestling, scuffling, horse play, kidding and goosing have no place in any working establishment. Things may be started in all innocence and without intent to cause harm, but too often there is some unforeseen happening that results in a serious or perhaps fatal accident to one or several employees. Cut out the kidding game."—Bulletin of Youngstown Sheet & Tube Co.

Pumps, Condensers and Cooling Systems

IMPORTANT developments during recent years in the construction, installation and operation of pumps, condensers and cooling systems, have created a demand for an up-to-date and comprehensive treatise on the subject of Water Handling in the Power Plant.

The January 1st, 1916, specialized number of Practical Engineer will cover with thoroughness, accuracy and detail every phase of this important subject. In its completeness it will contain information of daily use never before collected, all put in available form and carefully indexed.

Pumps

The section on pumps is designed to cover such pumps as are used for ordinary power plant purposes, including boiler feed, condenser equipment, house and fire pumps, securing of water supply from wells, and brine handling pumps for refrigerating plants.

Reciprocating Pumps

The first topic under this section will take up the types of reciprocating pumps, including the piston, plunger and bucket types, and treating of the details of construction for each type, and also of the methods of driving, such as the direct steam power drive, both electric and belted, and the reason for use of single and multiple cylinders in each case.

Details of Water Ends

The details of the pump end will first be considered, treating of the friction of water in pipes, the suction lift possible for different temperatures of water, methods of packing the piston and plunger to prevent leakage, the types of valves and arrangement of valve discs, with the details fully explained, and the methods of determining whether valves will be satisfactory or not.

The types of pumps, whether piston, inside packed plunger or outside packed plunger, for different uses, will be explained, and tables given of pump capacities, speeds, power required for different types.

The use of the air chamber on both suction and discharge ends will also be taken up, indicating size of chamber required, and the proper location to secure satisfactory results. Special types of flywheel pumps, for such purposes as elevators, will be treated and details of construction given.

Steam Ends

The steam end of pumps will be the next topic, treating, first, of the construction and action of valves for the single cylinder or simple steam pump, and giving the details of the valve motions for commercial makes; second, dealing with the action of the duplex pump and the variation in detail of different makes, and explaining the method of setting and adjusting duplex valves.

Compounding

Compounding of a pump, particularly a duplex pump of large size, gives special steam economy, because of the necessity for taking steam full stroke in the simple pump. The reasons for compounding, the gain from it, and the ratio of cylinder volumes found desirable will be discussed.

Power Driven Pumps

Power pumps have certain advantages for some purposes, and they will be given full space, showing the construction and arrangement of cylinders, methods of drive, and ratio of speed reduction desirable, with table of capacities and speeds, and also of the sizes of motors or belts required to drive them.

The Rotary Pump

The second main topic will be the rotary pump, its principles and advantages, the velocity flow desirable, action of screw pumps and of propeller pumps, and details of construction of the different types.

Centrifugal and Turbine Pumps

Following this will be the section on centrifugal pumps, which will give the conditions for economy, show the relations of speed, head, area and capacity in this type of pump, and will ex-

plain fully the action of the simple centrifugal, the volute, the multi-stage and the turbine types, and will give tables of speeds, capacities and sizes for each. It will show, also, the proper method of installation of centrifugal pumps, the provision necessary for priming, different settings for vertical and horizontal mounting, pump characteristics and curves, and costs of pumps and pumping.

In the part on Details of Pumps, types and shapes of impellers will be studied, and the proper design for the best effect. Also, the details of commercial centrifugal pumps will be shown for all prominent makes.

Direct Pressure Pumping

A class of pump not frequently used, but of great value in many places, is the direct gas pressure, which includes the air driven pumps, the Humphrey gas pumping engine, and the hydraulic ram. Full details of the different systems will be given, showing efficiencies and proper uses for these special types.

The Air Lift

In the section on Air Lift Pumping, the proportions of the lift for good results under different conditions, air pressure needed, and the amount of air required for various flows, the methods of controlling these wells from a distance, details of the foot pipe, the discharge head, and methods of air boosting for long distance pumping will be fully described. Details of different commercial systems will be given, and full information furnished in regard to this method of handling deep well supplies.

Special Uses

A final section on pumps will be devoted to pumps for special uses, such as the dry vacuum, deep well, brine pump, pumps for heavy liquors, for acids and alkalis, and other special designs.

Condenser Types and Details

In the second division devoted to Condensers, the different types will be taken up,—surface, jet, barometric and centrifugal, dealing with the principles of heat abstraction, the methods of handling water and air, the latest developments in the arrangements of tubes in surface condensers, the proportions of piping, head, volume and jet in barometric condensers, the details of special centrifugal types, surface and volume required in surface condensers, and the details of commercial makes.

Condenser Installation

Full instruction will be given in regard to the proper installation of condensers to secure the best possible results as to vacuum and safety from backing up of the cooling water. Also, the special arrangements for turbine plants as used in modern practice will be fully treated.

Cooling Systems

Under the head of Cooling Systems, the natural draft and forced draft cooling tower will be treated, their method of action, the temperature drop possible under different conditions of air humidity, methods of construction of cooling towers to give maximum cooling effect, and the details of commercial makes.

Spray Nozzle Cooling

The second type of cooling system, the Spray Nozzle, will be fully treated, giving the latest developments in this field. The question of cooling ponds and of systems for cooling by sheet distribution of water will be gone into at length.

The cost of cooling, and the economy for various conditions will be outlined, to enable the determination of the advisability of cooling plants for any given case.

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CONTENTS

Fire Fighting and Fire Prevention. By Frank Williams. Illustrated. 1075
Blower Installations and Air Ducts. By R. A. Langworthy. Illustrated. 1078
Foundation Anchor Bolts for Machinery—VI. By Terrell Croft. Illustrated....1081
Watthour Meters. By O. H. Henschel. Illustrated....1084
High Voltage Trolley Line. By Clarence Renshaw. Illustrated 1086
Synchronous Motor Trouble. By A. Thomson. Illustrated. 1088
Petroleum as Fuel. By W. N. Best....1089
Jeremiah Judson, C. E....1090
Freezing of Air Pipes in Winter. By Frank Richards..1091
History of a Sawmill Engine. By H. H. Welbon. Illustrated. 1092
Winter Overhauling Saves Summer Shutdown. By A. G. Solomon. Illustrated. 1093
Trouble with Ammonia Compressor. By J. C. Hawkins. Illustrated. 1094
Oil and Driving Belts. By Karl Hoffman. Illustrated..1095
Letters Direct from the Plant: Locating Leaky Water Tubes. Boiler Construction. Repairing a Wrecked Cylinder. Internal Blowoff Piping. Some Properties of Rotary Converters. Cleaning Drain Pipes. Should Pulleys Be Covered? Pumps for General Use. Governor Gagpot Repair. An Electrical Stroke Counter. Safety Governor for Air Compressors. Repairing a Broken Gland. Babbiting Crankpin Boxes. Illustrated 1096
Successful Kinks from the Plant: Silencing Noisy Dashpot. Repairing Gland on Triplex Pump. Pump Trouble and Remedy. A Trigonometrical Kink. Making a Tight Ammonia Joint. Illustrated....1100
Questions Answered and for Answer: Furnace Problems. Steam Expansion. Massachusetts Examination Questions on Steam Turbines. Boiler and Engine Questions. 1102
Problems for Discussion by Readers: Load Distribution in Compound Engine. A Big Grate at Light Load. Proper Location of Expansion Valves. Distilled Water on Shipboard. Illustrated....1104
Pumps, Condensers and Cooling Systems....1106
Editorial: Getting Ready for a Peak on a Hand-Fired Boiler 1108
A. S. M. E. Meeting....1109
News Notes 1109
Protection of A. C. Tie Lines. Illustrated....1110
Improvements in Lea V-Notch Meter. Illustrated....1110
Venturi Nozzles for Diamond Soot Blowers. Illustrated.1111
Small Belted Alternator. Illustrated....1111
How Wiping Waste is Manufactured....1111
Crystal Ice Without Reboiling. Illustrated....1112
The Clefabco Belt Adjuster. Illustrated 1112
Hightower's Pipe Repair Plug. Illustrated....1113
Turning a Flywheel Off Center....1113
George H. Beebe....1113
Book Reviews 1114
Catalog Notes 1115
Trade Notes 1116

Getting Ready for a Peak on a Hand-Fired Boiler

Every power house is subject to a periodic demand for more power than is usually required and in nearly every plant the time at which such peaks may be expected is pretty accurately known. Yet, in the great majority of plants, the preparations made to meet such heavy demands on the boiler are not conducive, to say the least, to the best overall efficiency of the plant. The common practice is to have a supply of coal conveniently located and the fire free of ashes—apparently the logical preparedness, but actually a means of courting trouble.

The clean fire is, of course, a very desirable condition and the convenient supply of fresh fuel detracts only in that it is conveniently placed so as to permit easy and rapid heavy firing as the load is picked up. This is all wrong, for a peak is nearly always preceded by a period of decreased demands during which a thin fire is maintained on the grates, the draft open and with a clean fire efficiently transmitting its heat to the boiler contents. While this efficient operation of the boiler is in force, the boiler setting becomes comparatively cool, the rate of combustion being insufficient to allow the setting to store up much reserve heat, so that on opening the fire-doors for the supply of fresh coal to meet the demands of more rapid combustion necessary for generating the increased volume of steam which is to be withdrawn from the boiler during the peak, the drop in furnace temperature is quite marked and difficulty is encountered in maintaining the required steam pressure. Shoveling on more coal rather aggravates than overcomes the difficulty, and operation is inefficient and wasteful until there is some let-up in the call for steam. Complaints follow and an attempt to solve the difficulty is usually made by the installation of more boiler capacity.

Preparation for handling a peak load at the boiler should forestall the difficulty of maintaining boiler pressure at the commencement of the peak. If this is done, little difficulty will be encountered in holding the pressure during the peak until the demands are once more normal or light. The clean fire is still an asset; but instead of a nice *thin* fire on the grates before the commencement of increased demand for steam, there should be a nice *thick,* clean fire with the stack-damper as nearly closed as is feasible and still maintain fair efficiency. As the peak is picked up, the stack damper should be gradually opened until, when the peak of the peak is reached and the demands for steam are the greatest, the thick firebed is in a state of incandescence with the stack-damper wide open, without having inflicted upon the boiler the hardship of the chilling effect of opening the fire-doors to fire fresh fuel or calling upon the hot firebed to sacrifice heat to raise the temperature of the cold new coal to that necessary for ignition. After the peak has been picked up—not before—the regular firing for the decreasing peak load should be commenced and this presents no great difficulties to the capable fireman. It is after the load is actually on the boiler, ordinarily after the maximum load has been carried for an appreciable length of time, that the conveniently located supply of coal really becomes an asset which may be efficiently drawn upon.

While maintaining the thick firebed during the interval preceding the arrival of the peak, the boiler is not operating at its best efficiency, it is true, and there may be quite a perceptible rise in the percentage of carbon monoxide (CO) escaping to the stack; but this loss is not so serious as that which is nearly always entailed through the frantic efforts to maintain pressure in the ordinary manner of shoveling on more and more coal as the load on the boiler increases.

The thickness of the advisable fire to precede a peak, how soon before the arrival of the peak the thick firebed should be prepared and the degree to which the stack-damper can be closed, must be ascertained for each individual boiler, and no general rule can be advanced other than that the firebed should be as thick as that required for handling the contemplated peak when the combined boiler and grate efficiency is at its best. Experimentation with the stack-damper will then determine the advisable degree of closure and whether the boiler capacity is really sufficient to meet the demands of the peak.

A. S. M. E. Meeting

AT the annual meeting to be held at 29 West 39th St., New York City, Dec. 7 to 10, President John A. Brashear will deliver his address on Tuesday evening, Dec. 7, to be followed by a reception to the officers and members. Wednesday morning will be the business meeting, followed by a memorial to honor the late Dr. F. W. Taylor. At the professional session following, papers will be presented on:

Gas Producers and By-Products, by A. H. Lymn; Engineering Methods and Executive Problems, by Hollis Godfrey; Electric Elevators, by David Lindquist; Small Turbines vs. Engines, by J. S. Barstow; Connors Creek Plant of the Detroit Edison Co., by C. F. Hirshfeld; Proportioning Chimneys, by A. L. Menzin; Design of Fire-Tube Boilers, by F. W. Dean; Higher Steam Pressures, by Robert Cramer; Handling Boilers to Prevent Corrosion and Scale, by A. H. Babcock.

Wednesday afternoon, there will be 3 sessions: Railroad papers on Parallel and Radial Axle Operation From a Single Set of Cylinders, by Anatole Mallet; Four-wheel Trucks for Passenger Cars, by R. V. Wright. Textile papers on Forced Circulation Hot Water Heating, and others. Shop papers on Electric Operation and Control of Machine Tools, by L. C. Brooks; Abrasive Wheels, committee report.

In the evening a smoker will be held at the Society Rooms for getting acquainted, and group conferences.

Parallel sessions will be held Thursday morning on: Power Plant papers, Insulating Properties of Commercial Pipe Covering, by L. B. McMillan; High Vacuum Surface Condensers, by G. H. Gitson and P. A. Bancel; Circulation in Horizontal Water-Tube Boilers, by P. A. Bancel; Hydraulic Plant at Ford Farms, by M. A. Replogle. Miscellaneous topics, Air Flow Through Thin Plate Orifices, by E. O. Hickstein; Strength of Stoneware and Porcelain, by J. E. Boyd; Foundations, by C. T. Main; Oil Engine Vaporizers, by Louis Illmer.

Thursday afternoon is open for excursions and business appointments and in the evening the annual dinner and dance will be held at Hotel Astor.

Friday morning session will be devoted to industrial safety, a number of papers being in course of preparation covering Safety Standards; Reducing Accidents; Compulsory Compensation Laws.

News Notes

H. O. HEM has become connected with the Toledo Scale Co., of Toledo, Ohio, as chief engineer in charge of the design and details of its larger automatic weighing machinery, which is now made for use in shops, factory and store houses.

CLEMENT RESTEIN Co., of Philadelphia, which for 22 yr. has been manufacturing steam and hydraulic packings and mechanical rubber goods, announces a change in firm name, and will hereafter be known as Belmont Packing & Rubber Co. The principal reason for the change in name was to make it descriptive of the company's business, as the trade name "Belmont" has been used for its various products for many years.

About a year ago, a factory site was purchased at Frankfort Junction, and recently the entire factory equipment has been moved into a new plant at that location, but the general office is retained at the old location, 133 N. Second St. The new factory is at Butler and Sepviva Sts., with private siding from the Pennsylvania Railroad, and has a frontage of 693 ft. on Butler St., with ample room for further expansion. The new factory is a brick structure, 140 by 270 ft., with 35,000 sq. ft. of floor space and a complete modern power plant.

U. S. CIVIL SERVICE COMMISSION announces an examination, Dec. 21, 1915, for marine engine draftsman for submarines, to fill a vacancy in the office of the Inspector of Machinery, Fore River Ship Building Co., Quincy, Mass., and another in the office of the Inspector of Machinery, Busch-Sulzer Co., St. Louis, Mo., at $5.04 a day each, and vacancies as they may occur in similar positions at entrance salaries ranging from $4 to $5.04 a day. Applicants must have had an education of at least 2 yr. in engineering in a reputable technical school and at least 2 yr. drafting experience; or 4 yr. suitable practical experience. Apply for Form 304 and special form, stating the title, Marine-Engine Draftsman for Submarines (Male), to the U. S. Civil Service Commission, Washington, D. C.

U. S. CIVIL SERVICE COMMISSION announces an examination for marine engine and boiler draftsman, on Dec. 8 and 9, 1915, to fill a vacancy in the Machinery Division of the U. S. Navy Yard, New York, N. Y., at $5.04 a day, requiring the services of a person thoroughly familiar with the design and construction of marine steam turbine engines, especially the Parsons turbines. Applicants must have had the equivalent of a complete course in engineering in a technical school of recognized standing and at least 3 yr. experience; or the equivalent of a high-school education and at least 5 yr. experience in marine engine and boiler work. Apply for Form 1312, stating the title, Marine Engine and Boiler Draftsman (Male), to the U. S. Civil Service Commission, Washington, D. C.

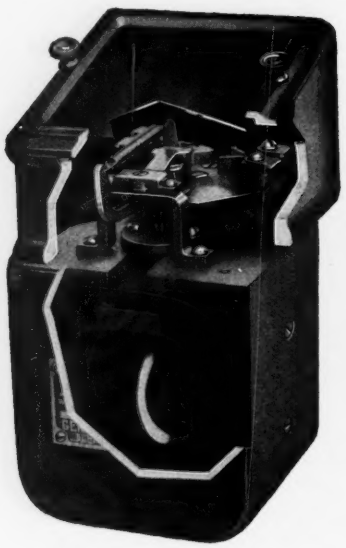
Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Protection of A. C. Tie Lines

SINGLE-POLE, double-throw relays of the type illustrated have recently been developed by the General Electric Co. These relays provide a simple and effective means of isolating trouble automatically on a single tie line joining parts of an alternating-current system. Two relays connected together by pilot wires are required on each end of a 3-phase tie.

Under normal conditions, irrespective of the direction of the power, which may reverse at any time over the entire tie line, depending on the distribution of the load and the characteristics of the system, the relays have no effect on the oil switches. If, however, a short circuit occurs in the tie line while power is being fed



CIRCUIT OPENING AND CLOSING ALTERNATING-CURRENT REVERSE POWER RELAY

from one part of the system to the other, this power will go directly into the short, while the power in the tie between the short and the part of the system previously receiving power will reverse and also feed into the short. This will operate the contacts of the relay in the reversed portion of the line, which will cause the oil switches on both ends of the line to trip and isolate the line from the rest of the system.

The relays will not operate on overload, or on trouble on other lines unless accompanied by a reversal of power only on one end of the line which they are meant to protect. They will, however, operate on little reverse power, even at low voltage and low power-factor, and are consequently of great value for the service recommended.

Improvement in Lea V-Notch Meter

THE Yarnall-Waring Co. is now placing on the market a new and more heavily designed integrator for use on its "Lea" V-Notch Recording Liquid Meter.

Figure 1 shows the type of "Lea" V-notch meter integrator which has been used with excellent satisfaction for a number of years, and Fig. 2 illustrates the new type.

In the new type the aluminum dial, which drives the integrator counter, is in turn driven by means of a pendulum clock movement specially built by the Seth Thomas Co. for this service. It has a double heavy spring pendulum movement, which is so constructed that vapor and dust do not seriously affect its accuracy.

It has been found in practice that it is advisable to use a separate clock mechanism for the operation of the integrator from the clock mechanism which operates the chart

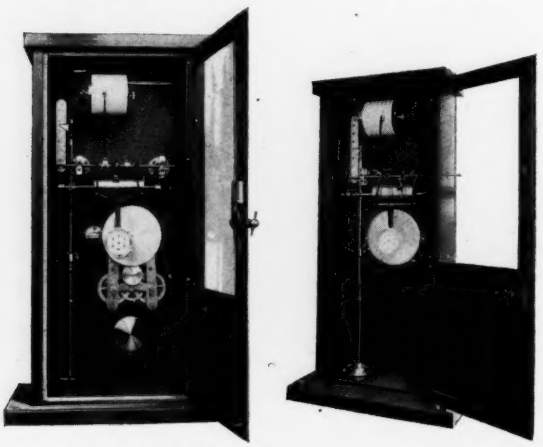


FIG. 1. LEA V-NOTCH METER INTEGRATOR FORMERLY USED
FIG. 2. RECENTLY IMPROVED TYPE METER

recording mechanism, for the reason that if either clock should be deranged in service, the user still has the other clock record to depend upon. Hence it is impossible to interrupt the readings of the "Lea" Meter.

In addition to this advantage, it is found by using 2 clocks that one can be used as a check against the other, and in this way more dependably accurate results obtained.

The original "Lea" V-notch instruments were built with hand screws for making adjustments. It has been found in practice that in a few instances in power plant service, vibration sometimes caused these thumb screws to

loosen slightly. Hence, in the new model instrument, as shown in Fig. 2, heavy screws with slotted heads have been used for making adjustments. A screwdriver alone is needed for making such adjustments, and when carefully made it is found that they are more secure than with the old type thumb screws.

In the new type instrument the pen arm adjustment has been simplified, also the yoke supporting counter dial on the integrator.

The case is so designed that the instrument cannot be affected in any way by steam or vapor getting into the instrument case, nor even by serious vibration.

The door of the case is equipped with a tongue entering a felt-lined groove. A 3-way locking device jams the door against the felt, making practically an air-tight joint. This is a valuable improvement, especially for an instrument which is sometimes set in damp or dusty boiler plants.

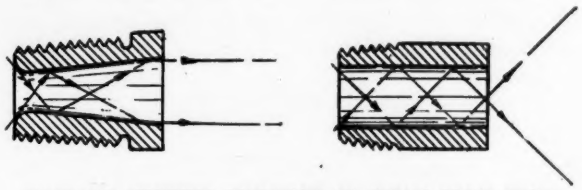
All of these improvements have resulted in a more sturdy and dependable instrument than the old type, which users everywhere found gave satisfaction.

Venturi Nozzles for Diamond Soot Blower

MARKED effectiveness and general high efficiency of Diamond mechanical soot blowers is brought about, to some extent, by the use of Venturi steel expansion nozzles.

The principle of the expanding nozzles is to convert and direct the heat of the steam into kinetic energy. The steam expands within the nozzles, and each particle at every point acts upon the particle or molecule directly in front of that point, increasing its velocity. The direction of motion is controlled by the divergement walls of the nozzles.

The expansive force of the steam issuing from the throat of the nozzles causes the molecules to strike the walls of the nozzles, from which they rebound at the angle of impact, changing the course of lateral expansion to a course parallel with the axis of the nozzles and as no energy is wasted by transverse movement, the maximum amount of available energy with the steam expanding adiabatically between the initial and final temperatures is converted into energy of velocity.



DIAGRAMS SHOWING DIRECTION OF STEAM FLOW FROM VENTURI AND STRAIGHT NOZZLES

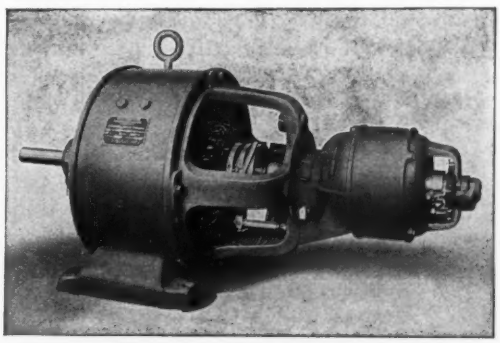
By the use of Venturi nozzles it is claimed that the steam velocity is increased to approximately 3⅓ times that from a straight nozzle and it is necessary to use only about half the number of blower units required to clean a water-tube boiler when the straight nozzle is used because of this greatly increased velocity. Also, the amount of steam required for blowing is greatly decreased because the increased velocity cleans the boiler thoroughly in about half the time required when the straight nozzles are used.

Venturi steel expansion nozzles are used in all Diamond soot blower systems, and the rights to their use in this capacity are owned and controlled by the Diamond Power Specialty Co.

Small Belted Alternator

THE term "generator" to many minds brings up the vision of huge turbo-alternators, equipped with the most elaborate devices to ensure absolute reliability. Yet there are hundreds of small plants the demand of which does not warrant the use of such huge units, but where reliability is just as important.

For such service, the Westinghouse Electric and Manufacturing Co. has perfected a small belted alternating-current generator, with direct-connected exciter, an arrangement resulting in a compact unit, as well as securing the utmost reliability and independence of operation.



20-KV.A. 3-PHASE, 60-CYCLE, 240-V. BELTED ALTERNATOR

This generator has a rated capacity of 20 kv.a., 3-phase, or 14 kv.a., single phase. The standard frequence is 60 cycles at a speed of 1800 r.p.m., and the machine can be furnished to give either 120, 240, 480 or 600 v.

How Wiping Waste is Manufactured

IT is surprising the number of people who take waste merely for what its name implies, rather than consider it as a manufactured product. But a man who had visited the plant of the Royal Manufacturing Co., of Rahway, N. J., told us different.

Fundamentally, waste is waste—that is, it is the left-over material of wool and cotton, after they have been loomed for fabric manufacture. The quality of the basic waste depends upon the quality of the cotton and wool from which it has been refined. In order to be assured of good basic waste, manufacturers purchase only from certain cotton and woolen mills whose products are of a known high standard.

The raw material is then full of grease, dirt, dust and other impurities which must be removed in order that the product retain its absorbent qualities. Before cleaning it, however, it is thoroughly combed by means

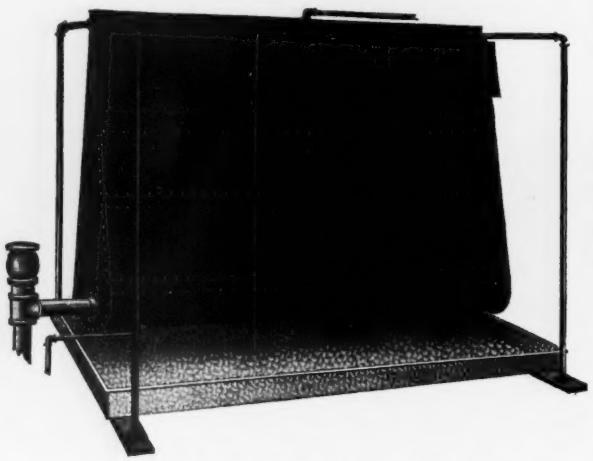
of the huge cylinder with sharp spikes projecting from it, which rotates and untangles the waste, making it soft and spongelike. It is then gone over and freed from wood or metal splinters, grime and impurities of all kinds; then separated into grades, according to the softness, smoothness and fluffiness of the product. The colored grades are usually inferior to and cheaper than the white, but for use in certain plants where the machinery is not delicate in construction, they will readily suffice.

After both the white and colored waste have been carefully inspected for purity and tested for their absorbing qualities, they are subdivided into other grades, according to softness and texture. Each grade is then packed into bales, running anywhere from 5 to 500 lb. and then pressed compact to take up the least possible room. In the case of the Royal Mfg. Co., the waste is then covered with neat, durable burlap, reinforced with steel bands, and each individual bale is trade-marked.

Crystal Ice Without Reboiling

THE B. M. C. Flask Steam Condenser after careful study and experimenting has been constructed so scientifically that it is now possible to obtain clear crystal ice without the expense of having a reboiler, which heretofore has been necessary for the production of crystal ice in most plants.

The internal baffle plate construction makes a counter current arrangement that produces rapid condensation and causes the steam to circulate back and forth so that the coolest vapor is forced to the top where it encounters the coldest condensing water.



THE B. M. C. FLASK STEAM CONDENSER

The condensed water percolates through these baffle plates into the bottom chamber where it passes through the hottest steam again, and is reboiled, emerging pure, through the distilled water connection.

Near the top a vent is provided so that the gases and impurities in the water may escape without permitting any waste of steam. The oval bottom allows the condensing water to continue downward until it reaches the lowest point, so that all surface is used in the condensing process, and no dry, hot surface need be left exposed to burn out quickly.

Passing from the bottom of the B. M. C. condenser the condensing water is hot enough and free enough from solids to be taken direct to the boiler without use of the feed heater.

Special sheets of 99 per cent pure iron with heavy galvanized coating are used of 12 gage thickness. This thickness of material gives durability and strength, and when reinforced by the baffle plates makes a thoroughly substantial apparatus, and yet thin enough to afford great efficiency.

The pear shape of the B. M. C. condenser provides a large body of the hottest steam in the bottom of the apparatus through which the distilled water can percolate and be reheated to boiling point and be freed from any remaining gases, and makes cleaning easy. The large hot surface at the bottom also serves to heat the condensing water for boiler use.

The ends are removable and yet fit tightly and securely over a packing that makes a perfect joint, so that only a few minutes are required to remove them, and access is then easily gained to the inside of the chambers for cleaning.

The condenser is supported from the top, by attaching heavy galvanized straps to the end angle irons and forming them into rigid loops through which the overhead supporting rod or pipe may be passed.

The water distributer provides even flow of water from end to end of the condenser in all kinds of weather, the perforated device preventing the wind from disturbing the flow of water over the full length of the condenser. This distributer furnishes enough water to give maximum results and prevents almost every possibility of waste. The B. M. C. condenser is manufactured by the Butler Manufacturing Co., Kansas City, Mo.

The Clefabco Belt Adjuster

IN any plant where belts are used, an important part of the work is the rapid and proper repair of belts; to accomplish this has been the aim in the design of the Clefabco Straight-Line belt adjuster made by the Cleveland Fabric Belting Co.

CLEFABCO STRAIGHT-LINE BELT ADJUSTER

From the illustration herewith the principal features of this belt adjuster will be observed. It should be noted, however, that the drive is by means of a worm gear, which is positive, and enables the operator to give the belt the exact tension desired. The clamps are quick-acting, one side of each having a shackle fastening which

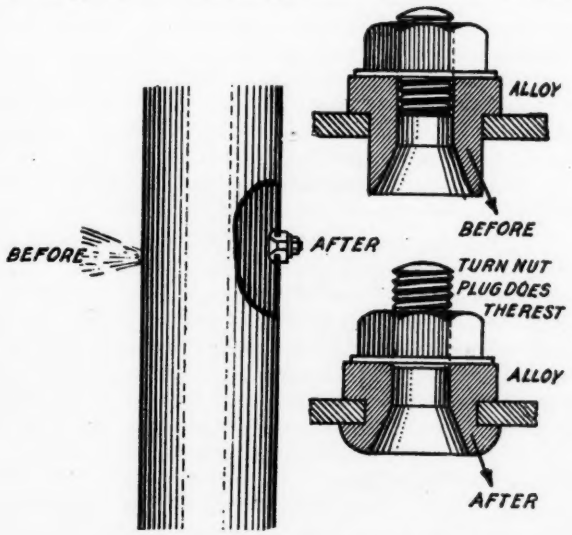
permits putting the clamps over a slack belt or inserting the ends of a broken belt quickly; after this the operator swings on the shackle, tightens the clamps and turns the crank until he has the desired tension.

When not in use, the adjuster can be separated into 2 sections, making it easy to carry and apply to overhead or difficult drives. It is made in sizes to handle belts as large as 12 in.

Hightower's Pipe Repair Plug

TO repair holes in piping, an ingenious and serviceable patch plug has been devised by C. G. Hightower, of Samoa, Cal. It is easily applied, and because of its simplicity, cheapness and effectiveness, will find its place in the stock of many power plants.

As may be seen from the accompanying illustration, the device consists essentially of a plug with taper headed expansion bolt and nut for expanding it after it has been put in the hole from the outside. The plug is composed of a soft alloy, which does not deteriorate



EVER READY, STOP LEAK, PATCH PLUG

in contact with steam, air or ammonia. When a leak appears, the hole is reamed to proper size to insure sound metal surrounding, and the plug is inserted and tightened into place. The greater the pressure, the tighter the plug holds, as it is suitable for any steam pressure, superheated or saturated.

All sorts of condenser tubes, pipes, tanks and gas holders can thus be easily, quickly and cheaply repaired.

Turning a Flywheel off Center

THE average barring device or crowbar method fail in the required duty when there is limited space in which to operate them. There has recently been placed upon the market the No. 310 Simplex emergency jack—really a crane and jack combined—which turns the heaviest flywheel even though there are no notches on the periphery.

This jack pivots on its own base or may be locked in a vertical position. When tilted, it pushes or pulls at the angle of inclination anywhere within the angles of 30 to 90 deg. to the horizontal. The cap of the jack has a recess into which the links of a chain may be dropped and firmly held. A double lever socket makes the lever bar position convenient to the user with the jack at any angle.

In turning a large flywheel, the jack is inclined on its base to the flywheel surface and the chain, which forms a part of the equipment, hooked around the nearest spoke with the other end in the cap of the jack. A few easy strokes of the lever place the flywheel in the desired location.

This jack is also useful around the engine room and in the factory for moving heavy machinery, and on the outside for general use. The capacity is 15 tons, height 22 in., lift 12 in. Templeton, Kenly & Co., Ltd., Chicago, are the manufacturers.

George H. Beebe

MR. BEEBE, who was one of the founders of the Fisher Governor Co. and since 1906 its president, died suddenly on Nov. 7 at his home in Marshalltown, Ia., after an illness of 7 weeks from internal cancer. He was a native of Iowa, born in 1853, and after a good education entered the machinery field at 21 yr. of age. In 1875, he started a shop in Marshalltown, which continued until 1884 when, in partnership with the late William Fisher, under the name of Fisher and

Beebe the manufacture of the Fisher steam pump governor was begun. Four years later, the Fisher Governor Co. was organized by the 2 partners and the late A. E. Harris and it was incorporated in 1890.

Mr. Beebe was a man who enjoyed the society of his fellows, and besides the many business friends, increased the circle through lodge affiliations. He was a member of the Masonic order, having passed through Commandery and Shrine degrees, also of Modern Woodmen, Royal Highlanders and Red Men. He had been an Iowa

state officer of the N. A. S. E. and was at the time of his death president of the Marshalltown local association. The burial was with Masonic Rites.

The news of Mr. Beebe's death will bring a sense of loss to many who have enjoyed his acquaintance and profited from his cheerful help at the national engineers conventions for years past.

Book Reviews

INTERNAL COMBUSTION ENGINES, by R. L. Streeter; 418 pages, 240 illustrations; New York, 1915; First edition. Price, $4.

While prepared to be used as a text book on the subject of internal combustion engines, this volume may also well be used by the practising engineer. Considerable of the higher mathematics is employed and as a consequence will not be of great value to the practical man. Those, however, who have had previous training in thermodynamics and mathematics will find much valuable information on the subject of gas- and oil-engines and allied subjects.

The first few chapters of the book cover the general subjects of thermodynamics, principal gas engine cycles, fuels and combustion, the Otto and Diesel cycles in practice, ignition and ignition systems, carburetion and carburetors, governing, cooling of engines, power, efficiency, speed and sizes.

Chapter XIV, on The Cost of Power Generated by Internal Combustion Engines, is of particular interest and value, comparisons being made therein between the cost of power as generated by the steam, gas and oil engines.

Chapters XV to XVIII inclusive deal with Types of Engines, Characteristic Oil Engines, Large Gas Engines and the Humphrey Gas Pump.

Details of gas engine design are taken up in Chapters XIX to XXIII.

TEXTBOOK OF ENGINEERING THERMODYNAMICS, by Lucke and Flather; New York, 1915; 688 pages, 189 illustrations; first edition. Price, $5.

With the broader knowledge of heat engineering in its various phases demanded of engineers comes the requirement for a more thorough treatment of this subject by our technical schools, and to meet the existing condition this text book has been prepared. It is an abridgment of C. E. Lucke's Engineering Thermodynamics rather than an original work, rearranged to meet the needs of technical schools. In order to give a thorough discourse of this all-important engineering subject, considerable mathematics has been introduced so that as a whole the book is intended more for those possessing a knowledge of the higher mathematics than the practical man.

The subject is divided into 3 general parts: Part I deals with the conditions surrounding the doing of work without any consideration of heat changes; Part II, with heat gains and losses without reference to work involved; and Part III, transformation of heat into work, or work into heat in conjunction with changes in the condition of substances. These parts are then divided into separate chapters with a further sectional subdivision.

The intention of the authors has been that those portions will be selected which will best articulate with other related subjects, serving more or less as a basis for them, thus allowing the text to supplement courses on gas power, compressed air, steam engines and turbines, steam boilers and power plants, refrigeration, chemical engineering, laboratory practice and research.

Numerous problems are introduced as an aid to the fuller understanding of the subject.

EXAMPLES IN ALTERNATING CURRENTS, by F. E. Austin; 223 pages, 70 illustrations; 1915. Price, $2.40.

While written primarily for the use of college students, this book may also well be used both as a text and for reference by the practicing engineer, whether electrical or mechanical or those pursuing the study of alternating currents without an instructor. Considerable space is devoted to notations employed in alternating-current work, a brief treatment of trigonometry and differential and integral calculus intended to bring out those important points having a bearing on the work to follow. Apparently the aim of the author in giving this treatment on mathematics has been to enable those not enjoying the advantages of complete courses in trigonometry and the calculus to understand the work with as much profit as the man trained in those subjects. Those having completed courses in the higher mathematics may find it profitable to review this section of the book before going to that devoted to the electrical subjects.

A number of pages are devoted to definitions of alternating-current terms followed by many practical problems bearing on the various phases of the work. In the solutions following many of the problems free use is made of the higher mathematics and in order to make the work as comprehensive as possible, the application of some of the elementary principles of calculus is explained in many of the examples and in some cases the correctness of the method employed may be checked by applying some other method.

An important feature of the book is the many valuable tables given as an aid to those having occasion to carry on alternating-current calculations.

"COMBUSTION AND SMOKELESS FURNACES," second edition, revised, by Jos. W. Hays, 1915, Chicago, price $2.

In this work, the author has met the needs of men engaged in engineering work for a book which takes up the matter of combustion in a non-technical manner, explaining the various influences which affect combustion, and giving the results of recent developments in the science of fuel burning.

The introductory chapter is on "Heat and Combustion," and in it the author gives the reader a clear understanding of the laws governing combustion in the furnaces of steam boilers, and presents the heat theories which have been worked out by authorities, and also explains the mechanical equivalent of heat, closing with a few remarks on latent, sensible and specific heat.

In the next chapter, subject of "Combustion and the Boiler Furnace" is taken up, followed by one on "Combustion and the Steam Boiler." "The Chimney Evil" then comes in for discussion, followed by "Smoke-

less Furnaces in General." A chapter is then devoted to Mechanical Stokers, describing the most used types. This is followed by a chapter on "Hand Fired Furnaces and Mechanical Draft," in which the writer goes into quite definite detail in regard to the construction of boiler settings for both natural and forced draft. In the closing chapter, the author points out some conclusions which he has drawn from his experience, and in an appendix describes and illustrates instruments of his own design for use in building up furnace efficiency.

As a whole, the book is interesting and instructive reading, and being void as far as possible of technical language, it is of value to anyone who is connected with the boiler room of a power plant.

Catalog Notes

PAMPHLETS that are now issued by the Society for Electrical Development, which is arranging for the celebration of Electrical Prosperity Week, Nov. 29 to Dec. 4, are "How to put on an Electric Show and Demonstration," which gives full directions in regard to the different kinds of exhibitions which may be put on, the apparatus which will be most likely to attract attention in the exhibits, and each step in handling the work; also, "How to put on an Electric Vehicle Parade and a Sociability Run," giving suggestions for the displays in the parade, how it should be organized and held, and telling how to handle a sociability run contest to attract the owners of electric vehicles.

Those interested in the celebration of Electrical Prosperity Week will find much of help and interest in these booklets.

THE LATEST PUBLICATION issued by the Lagonda Mfg. Co., of Springfield, Ohio, is a 24-page bulletin on the company's triple-acting automatic cutoff valves and nonreturn valves. This book briefly, but completely, discusses the function of these valves, and illustrates the several types made by the Lagonda Mfg. Co., which are the standard angle type and straight way valve, the low squat body valve for low head room and the horizontal valve. A copy of this bulletin will be sent to anyone on request.

THE TRIANGLE is the name of a publication issued by the Westinghouse Agent-Jobbers Association, East Pittsburgh, Pa. The October issue has an attractive cover showing Niagara Falls, in honor of the recent meeting of the jobbers held at that point.

The magazine contains a number of articles with reference to the sale of electrical products and is well illustrated throughout with views of interest to the electrical profession.

BULLETIN NO. 50, The Phenix Force Feed Lubricator, recently issued by The Richardson-Phenix Co., of Milwaukee, Wis., contains a complete description of the Phenix ratchet type lubricator; it also describes a new type, known as the Model "T." The catalog contains an interesting diagram, giving a comparison of the way in which mechanical and hydrostatic lubricators feed oil to engine cylinders. Numerous illustrations show the application of the Phenix lubricator to different types of engines, pumps, steam hammers, etc.

Bulletin No. 60 contains much new information concerning the Richardson Model "M" sight feed oil pump. Interesting illustrations show the process of manufacture from the raw material to the finished lubricators on the test rack and give a good idea of the manner in which the pumps are drilled and milled from a solid block of cast iron. A chapter on gas engine lubrication discusses the question of timing the admission of oil so that it is forced directly onto the engine pistons. Other items of interest are a description of the new Richardson air spray attachment; also the steam and electric attachments for heating the oil in the lubricator reservoir. Copies of these bulletins may be had upon request.

CONSTRUCTION AND OPERATION of Thomas patent spray heads for cooling condensing water and for industrial use, are explained in Bulletin No. 18 of C. H. Wheeler Mfg. Co., of Philadelphia.

PAMPHLET "G," from Illinois Stoker Co., Alton, Ill., covers the construction and description of the company's latest design of chain grate stokers, with which construction, and by the use of dampers, the rating of the grate can be cut back to any load desired.

OZONATORS for use in stores are the subject of Sprague Electric Works Bulletin No. 49,127, which describes a typical installation in the basement display room of a large department store.

Bulletin No. 49,126 describes and illustrates Sprague electric ozonators for cold storage warehouses.

DETROIT STOKER catalog, just published by Detroit Stoker Co., Detroit, describes the Detroit "V" Type stoker, giving advantages over hand firing, method of operation, advantages of the fire brick arch and description of Detroit stoker engines. Some Detroit stoker installations as found in large power plants, mercantile and manufacturing establishments, are illustrated.

POWER PLANT SPECIALTY CO., Chicago, has issued Bulletin No. 106, relating to the Vater water softening system. The bulletin discusses the effects of mineral compounds in hard water when used for boiler feed purposes, and gives an estimate, based on a 1000-hp. boiler installation using Lake Michigan water, of savings effected by a water softener.

LINE MATERIAL and Rail Bonds for Mine and Industrial Haulage, is the subject of General Electric Co.'s Bulletin No. 44,005, superseding in part Bulletin No. 4916. This contains 76 pages of descriptions, illustrations and data on material used in the construction of overhead trolley systems and track return for electric haulage in mining and industrial plants.

THE COST of Pumping Water is the title of a collection of graphical charts with accompanying explanatory text issued by the DeLaval Steam Turbine Co., of Trenton, N. J. The object of the publication is to facilitate computation of the overall economy of different types of steam pumping units, having given the cost of fuel, steam pressure, rate of interest, cost of apparatus and other variables.

INGERSOLL-RAND CO., 11 Broadway, New York, recently issued Form 76, an 80-page catalog whose subject is "Water Lifted by Compressed Air." It is a very complete treatise on the air lift and explains in detail the air lift system of pumping. To all those in

any way interested in adequate water supply, a copy of this booklet will be found invaluable, since it intelligibly presents all the facts essential in analyzing a proposition involving the use of clean water in quantity.

CONGLOMERATE ORE Bulletin No. 112, from Williams Patent Crusher & Pulverizer Co., St. Louis, Mo., describes the company's chain hammer trommel mill, or crusher, which is built in 2 styles: the quartz crusher, or heavy machine, and the conglomerate ore crusher, a relatively light weight machine.

THE WESTINGHOUSE Electric & Mfg. Co. has just issued Leaflets Nos. 2389 and 2390 dealing with belt driven and engine driven a.c. generators, respectively. The capacities of these generators range from 25 to 1750 kv.a. and are thoroughly described and illustrated in these publications. A number of installation views of each type are also shown.

Trade Notes

A NEW PUMP for residence service, marketed by the Columbiana Pump Co., of Columbiana, O., is double acting, cylinder type, with capacity of 125 gal. per hr., at 130 r.p.m., and is brass fitted to minimize corrosion. This is arranged to pump the water into a pressure tank, and also to supply the air necessary for the pressure cushion, regulation being possible to take in proportion of air per stroke.

The receiver tank is furnished in sizes of 52 to 100 gal. for driving the pump. A standard Westinghouse 1/6-hp. motor is used for either alternating or direct current, as desired, with spring idler to keep the tension on the belt connecting the motor pulley to the pump pulley at the right amount at all times. Automatic switches are set to start and stop the motor at the desired pressures.

THE NEW Oster Fountain Oil Flood, a vital feature now incorporated in all Oster power pipe-threading machines, does away with all pipe around the die-head. Any operator knows how much inconvenience and annoyance this avoids. The oil is forced by a constant speed pump through the die-head, flooding the pipe constantly on all sides, by a stream just in front of each die. The force of the stream is so great as to wash away all chips, flush the die-head, and keep the thread clean. This adds much to the life of the die and the quality of the cut. Through a strainer, the oil drains into a reservoir in the base of the machine and, returning to the pump, is used over and over without waste.

By writing for sheet No. 34, to The Oster Mfg. Co., 2055 E. 61st St., Cleveland, O., a complete description of this new oiler, together with illustrated catalog, can be obtained.

WESTINGHOUSE Electric & Mfg. Co. reports the following among recent orders: The American Writing Paper Co., a 550-hp. Westinghouse motor at its Platner and Porter Division Plant, at Unionsville, Conn.; Berlin Mills Co., of Berlin, N. H., 20 a. c. motors, aggregating 365 hp., for use in its paper mills; The Unity Paper Mills, Inc., having recently taken over the old property of the Potsdam Paper Co., of Potsdam, New York, are bringing this mill up to date through the installation of electric drive by Westinghouse motors.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

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POSITION WANTED—As Meter Foreman and Power Salesman. Have had nine years' practical and technical experience. Thoroughly familiar with the requirements of the Public Service Commission of Pennsylvania. Address Practical Engineer, Box 405, Chicago, Ill. 11-1-3

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POSITION WANTED—By engineer, age 37, married, where reliability, capability, efficiency and economy would be appreciated. Prefer Chicago or vicinity. Address Practical Engineer, Box 411, Chicago, Ill. 11-15-2

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POSITION WANTED—As advance sales prospect man with firm manufacturing or selling power plant machinery, by thoroughly practical engineer with several years' traveling experience. Can furnish my own auto if desired. Address Practical Engineer, Box 412, Chicago, Ill. 11-15-2

POSITION WANTED—As operating engineer; perfectly at home in either electric lighting or ice plants; 15 years' continuous experience; Married, sober and reliable man. Address E S. C., care Practical Engineer, Chicago, Ill. 11-15-2

POSITION WANTED—By man 26 years of age. Have had 28 months' experience as general man around stationary power plant, and 2 yrs. running traction engine; also hold fireman's license. Reference will be furnished to any one wishing to correspond with me concerning position. Address Geo. M. Bucey, 1614 O St., Lincoln, Neb. 11-1-3

POSITION WANTED—By engineer with years of experience in ice and electric light plants. Understand both a.c. and d.c. machines. Am a graduate of one of the best colleges in Middle West. A1 references. Ezra D. Dumas, Clarinda, Iowa. 12-1-1

POSITION WANTED—By engineer in medium sized power plant, or large coal mine. Have Illinois license; 7 years' experience with steam engines and boilers. Some experience with electricity. Good habits. References. 24. Illinois preferred. Address W. E. Rohline, Box 224, Farmington, Ill. 12-1-1

POSITION WANTED—By young man with 10 years' practical experience from boiler room up. Hold first-class Massachusetts engineers' license. Will go anywhere. Am total abstainer and can furnish A1 references. Address Practical Engineer, Box 393, Chicago, Ill. 12-1-1

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WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Calif.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Calif.; Washington, D. C. This is an excellent chance for a hustler, who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf

FREE ENGINEER BOOKS and power plant tool and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Address Practical Engineer, Subscription Department, Chicago, Ill.

Wanted

WANTED—Agents handling engine and boiler-room specialties in every section for side line paying large commissions. Give experience, line carried, and territory covered. Address Practical Engineer, Box 381, Chicago, Ill. tf.

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield, Ohio. tf.

For Sale

BOILERS: (two) 250 H.P. Heine water-tube boilers, 150 lb., $950 each; (four) 300 H.P. Sterling water-tube boilers, 150 lb., $1100 each; (one) 500 H.P. Sterling water-tube boiler, 200 lb., $1750. 110 volt lighting dynamos, General Electric make; 30 K.W., $200; 25 K.W., $175; 20 K.W., $160; 14 K.W., $140; 9 K.W., $100. Duzets & Son, 50 Church St., New York, N .Y. 12-1-1

Patents and Patent Attorneys

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

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ENGINEERS' POCKET MANUAL; 175 pages; gilt edges; bound in leather; edited by University of Tennessee; will be mailed every subscriber sending in one NEW subscription (not your own) to Practical Engineer.

Technical Books

ENGINEERS AND FIREMEN—Send 10c in stamps for a 40-page pamphlet containing a list of questions asked by an examining board of engineers. Stromberg Publishing Co., 2238-A Pope Ave., St. Louis, Mo. E.O.I-tf.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill.

Inventions

INVENTIONS commercialized on cash and royalty basis. Inventors and manufacturers should write Adam Fisher Mfg. Co., 2175 Railway Exchange, St. Louis, Mo. tf.

Sparks From The Advertising Pages

Standards of Practice for Business Papers

Adopted by The Federation of Trade Press Associations at Their Convention in Philadelphia.

The publisher of a business paper should dedicate his best efforts to the cause of the Business and Social Service, and to this end should pledge himself:

1. To consider, first, the interests of the subscriber.
2. To subscribe to and work for truth and honesty in all departments.
3. To eliminate, insofar as possible, his personal opinions from his news columns, but to be a leader of thought in his editorial columns, and to make his criticisms constructive.
4. To refuse to publish "puffs," free reading notices or paid "write-ups"; to keep his reading columns independent of advertising considerations, and to measure all news by this standard: "Is it real news?"
5. To decline any advertisement which has a tendency to mislead or which does not conform to business integrity.
6. To solicit subscriptions and advertising solely upon the merits of the publication.
7. To supply advertisers with full information regarding character and extent of circulation, including detailed circulation statements, subject to proper and authentic verification.
8. To co-operate with all organizations and individuals engaged in creative advertising work.
9. To avoid unfair competition.
10. To determine what is the highest and largest function of the field which he serves, and then to strive in every legitimate way to promote that function.

Practical Engineer has always maintained strict adherence to every one of the above standards of practice. Even before they were drawn up for adoption by the business press they were part of the policy of Practical Engineer. Is it any wonder, then, that its great family of engineer-subscribers have learned to rely absolutely on its editorial and advertising pages?

You'll find no better aid in your efforts to advance yourself—you'll find no better guide in the purchase of power plant equipment than Practical Engineer.